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Dorothy R. Taylor and David G. Stead.

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In preparing their papers for printing, members will greatly facilitate the work of the Editors if they will have them typed (open spacing and with blank column at side for notes), thoroughly revised and corrected—especially as regards technical nomenclature and descriptive matter—and furnish therewith a brief summary.

MEETINGS of the GEOGRAPHICAL SOCIETY OF NEW SOUTH WALES are held, unless otherwise notified, on the Second Tuesday in each month. In addition to the presentation of papers and lectures, members are reminded that Exhibits and Notes of Field Observations are welcomed. Visitors may be brought to the meetings.

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At a Special Meeting held on July 9, immediately preceding the Second Annual Meeting, Rule 15 was amended so as to allow all Students to join the Society as Associate Members. The full rule as amended now reads as follows:—

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THE AUSTRALIAN GEOGRAPHER

Vol. 1. NOVEMBER, 1929. Part 2.

Development of Northern Australia

With Special Reference to Australia's Tropical Fisheries

By DAVID G. STEAD.

(Based on Presidential Address, given at Annual Meeting, July 9, 1929.)

No subject bearing upon the economic development of Australia has given our people such great concern, or has been of such perennial interest, as that of the increase of settlement and of production in the lands of Northern Australia—more particularly in the areas of North Australia, Central Australia, and the northern half of Western Australia (usually known as "The Nor'-West"). Attention has always been focussed mainly upon the land itself, and but scant notice has been given to the potentialities of the waters surrounding our northern coastline. The fact is that, although Australians are thoroughly expert in the development of pastoral and agricultural industries and in mining, they know but little of fisheries possibilities, and are very slow to move in this direction even in the populous parts of the country. Perhaps it is, therefore, not so surprising that references to the prospects of creating marine industries of vast importance in these northern regions have rather fallen on unheeding ears. Partly this apathy is due to a complete lack of understanding of the tremendous importance of fisheries production and what an outstanding economic factor this is in the world at present—and, one might say, more particularly in lands surrounding the Pacific Ocean (excepting Australia and New Zealand). This attitude of mind is all the more surprising when it is realised that so many millions of people in countries lying immediately to the north of this continent depend so largely on the products of the sea for their food and for many articles of daily use.

The main purpose of this address is to strongly emphasise the potential importance of Australia's tropical fisheries and to indicate lines along which future developmental work may be carried out. But before doing this I desire to traverse what I regard as the main facts contributing to, or determining, our occupancy of the land areas themselves in the regions under discussion. My principal reason for going over this old battleground is to make it quite clear that marine development in our tropical regions cannot wait upon, and is in no wise contingent on, the highly doubtful peopling of the land areas themselves, but must be taken up as a thing apart, in no way affected by the main factors controlling ordinary land settlement.

1.—LAND DEVELOPMENT.

It may be said with truth, I think, that there are two groups of protagonists in Australia who concern themselves with the discussions surrounding the future of Northern and Central Australia. There is one very large group more or less uninformed of the facts, and led by politicians and newspaper critics who as a rule are quite uninformed, that imagines that inland Australia and the tropical north are a rich "Land of Promise," a land "flowing with milk and honey," a "Garden of Eden," "awaiting the magic wand of human energy and enterprise" to change them into "hives of human industry," "capable of supporting large rural populations." The phrases strung together by me are actually the sort of nonsense that is frequently published, largely for the consumption of the uninformed or unthinking. Unfortunately, most of our people are unaware of the geographical controls that fix the location and limits of settlement and of pastoral and agricultural development. This applies equally to most of our legislators, who talk at random and with pathetic vagueness about the peopling and development of our "vast empty spaces," when, with a little more knowledge and with the aid of the professional geographer, they might be doing so much toward a sane and permanent advancement of our richer lands.

In a second group we have those who have given up the future use and development of our far inland and tropical areas as an absolutely unsolvable riddle. This also is a wrong view, although not fraught with the economic danger associated with the Land-of-Promise idea. Standing in between these groups are the working geographers of the nation, who are studying the land in every direction and helping to amass the data so necessary to a proper understanding of the possibilities—and the probabilities—of agricultural, pastoral, mining, and industrial development in any and every part of our continent.

Our vast empty tropical and largely arid or desert regions of Northern Australia have been at once a fertile field for the theories of the amateur migrationist and casual visitor, and the despair of publicist and statesman. Our history shows us that these same empty spaces have been the graveyard of many human hopes, and a "sink" to pour public money into—very largely to attempt the development of the undevelopable; at least as regards the Northern Territory. In saying this I do not for a moment imply that the areas comprised in the former Northern Territory or in northern Australia as a whole cannot be developed; but undoubtedly most of the attempts to undertake those "strong policies of development" which we have so often read about have originated from the highly erroneous idea that here was a fertile and sufficiently watered land that was merely languishing through neglect. Many years ago, some will remember, it was freely stated that South Australia had made a "holy mess" of things in the Territory, and that, with the passing of the overhead control to the Commonwealth and an energetic policy of development and migration, settlement would go on apace, and the land would flourish so quickly as soon to turn it from a heavy load into one of Australia's finest assets. But here (as was and unfortunately still is usual), in discussing the problems of the north, our prophets forgot to reckon with Nature; which, as regards the major portion of the area of Australia north of the tropic of Capricorn, has been very sparing in rainfall, and hard in general climatic conditions, making the path of primary production just about as difficult as it might be for all known land pursuits.

Had this northern area of Australia been the fertile land that our over-sanguine friends (and our traducers too) have alleged it to be, it is altogether beyond belief that in the course of the migrations of man over the face of the earth it would not have developed long ago a more or less fixed population—probably of a high order of civilisation, such as that of India, or at least of the Malay type. There is ample evidence that the Malays of the Bugis (Celebes) peoples have been familiar with parts of our northern coasts for several hundreds of years, and had the land not been of such a hungry type they would have settled there and grown their crops of rice and jungle fruits, as their kind do right throughout the Malayan and Philippine regions.

I do not desire to over-stress this, but draw attention to it for the purpose of indicating that, altogether apart from the question of white settlement in a torrid zone, the development of the great northern, and parts of the central, areas has but little in common with the development of fertile and relatively well-watered regions like the far eastern, the south-eastern, and the south-western portions of our country. It is important to remember this also for another reason; where the inducement is great enough—or should I say the reward?—the white man will settle almost anywhere, under the most difficult of conditions of climate; though in the end, when he has got what he can out of the country, he will remove himself to more habitable or more comfortable surroundings.

Already this tendency to move from the more arid of even our "settled" country has been noted by writers and statisticians, and accounts to a large extent for what Professor Griffith Taylor, in his book on "Environment and Race," calls "this centrifugal movement." The great increase in modern conveniences and comforts in our great cities adds to their attractiveness to the weary inlander, while still further emphasising the vast discomforts, or worse, of at least half the year far outback. How, then, are we to attract our own people to parts of our country which suffer at least from the same condition of aridity, with, also, a perpetual tropical condition of heat? Be it remembered, likewise, that a part of the far north-west is one of two or three of the hottest parts of the earth.

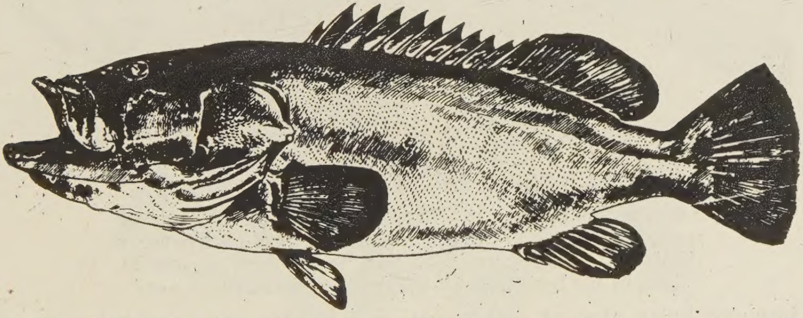
According to Taylor, there are approximately 180,000 people north of the tropic of Capricorn. But 170,000 of these are in Queensland alone, and at least 160,000 within easy reach of the east coast. There are only 9,000 in tropical Western Australia and Northern Territory. Further, there has been no progress made in the Territory in twenty years; while in the eight years from 1916 to 1923 the population decreased by 34%! These facts speak for themselves, and should be borne in mind by all students—whether the problem is one of simple development, or one of settling whites in those regions.

This does not signify, of course, that development is not practicable, but it does show that whatever inducement offered was not great enough to even hold the small number that was present. It is of considerable importance for us to remember this, as we are rather prone to lose ourselves in discussions as to the effect upon health of whites, consequent upon a prolonged period of residence in our tropics, rather than to range before us the actual inducement to permanent settlement there. Undoubtedly natural productiveness transcends habitability under some circumstances. To put it in another way: If the hot and arid areas under discussion afforded the same rewards for human labour as, say, the North Coast districts of New South Wales, is it at all conceivable that they would have escaped development by Australians? It strikes me as being very unlikely—and that after a residence in one of the hottest moist regions of the earth. However unsuited such places might prove to be for permanent residence, it would not have stood in the way of their opening up and development by whites, say in conjunction with native races or with introduced Asiatic labour, at a period long antedating the introduction of any definite White Australia policy, or, indeed, of Federation itself; for it must be remembered that these regions have been very well known for several decades past. At least the main facts regarding climate, rainfall, etc., required by the primary producer have been quite well known. It may be accepted, therefore, that the development of those regions is beset with great difficulties, primarily because of their inferiority, and that this inferiority is greatly accentuated by the "tropical" or highly torrid conditions which obtain throughout.

If that be so, then it is idle for us to expect any rapid development of the north—excepting, of course, that lying in the most easterly portion of Queensland—even under the best imaginable conditions. For a very long time, as far as one can see, and notwithstanding the suitability of isolated areas for the growth of a number of so-called tropical crops, the only land industries will be those associated with the pastoralist (which in torrid, arid areas never make for close settlement, whether white or black). While a very considerable, if relatively small, part of the Northern Territory[1] may be suited to the growing of crops like cigar tobacco, sisal hemp, cotton, tea, coffee, cassava, etc., strong economic reasons are opposed to the successful prosecution of such agricultural work in the face of the immense development just across the water, so to speak, in Java and associated lands, with an ideal soil and climate and a superabundance of cheap and efficient labour. Outside the work of the pastoralist, therefore, the only development of any importance in land industries—barring sporadic outgrowths connected with mining—that may be expected in those sparsely-populated or unpopulated parts of tropical Australia will be such as is concomitant to the further development of the present populated areas of the east, south-east, south, and south-west.

II.—MARINE INDUSTRIES.

My object in dwelling at some length upon the conditions surrounding the creation and development of land industries in



QUEENSLAND GROPER OR "BLACK COD" *(Promicrops)*
This giant fish often attains 400lb. in weight. It is abundant all round the northern coastline, and is a first-class food fish. Caught by hook and line, but could be trapped or meshed with the trammel net.

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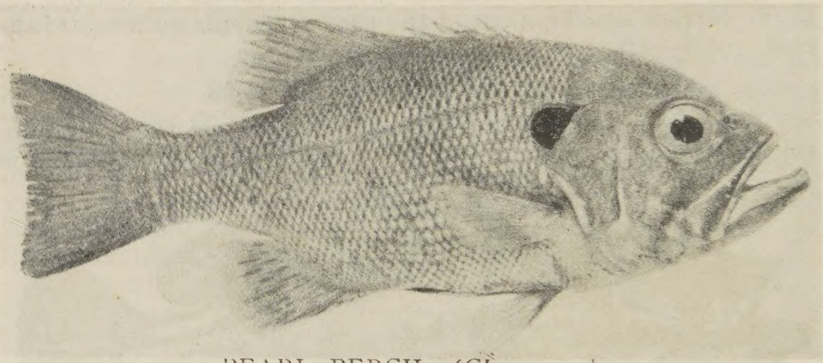
[1] I have refrained from using the divisional names of "North" and "Central" Australia (recently adopted by the Commonwealth) in this address, as they are very misleading, even to the Australian reader, in such a dissertation, unless with an explanation. I emphatically agree with Griffith Taylor in his protest ("Australian Geographer," Vol. 1, Part 1, 1928, pp. 25, 26) against the giving of these "directional" names to new territories. The effect has been to create still more geographical confusion in all descriptions of the Australian region, when it was already bad enough with "South" and "Western" Australia. To the average reader—whether in Australia or outside—North Australia signifies at least the best part of the northern half, and not a small central northern section. Similarly the geographical "Central" Australia is an area much greater than that shown officially under the name. I strongly support Taylor's suggestion that the northern part of the Territory should be called "Darwinia" and the central part "Arunta."

the areas of Australia under discussion is so that I may the better indicate that the development of the latent fisheries resources of the northern half of our coastline are to be viewed from an entirely different standpoint. However pessimistically one may view many of the bright promises as to the future of the land itself, quite an opposite view must be taken of our tropical marine resources, which are regarded by me as truly vast and almost unbounded! Spread over some thousands of miles of coastline are to be found edible and other commercial fishes in extraordinary abundance and great variety. Added to these is an astonishing array of sea-food products—including crayfish, crabs, prawns, shrimps, shellfish, turtles, dugong, trepang (beche-de-mer)—as well as commercial products of importance like pearl shell, trochus, green snail, shark products, and a variety of other things, including sponges, edible seaweeds, etc.



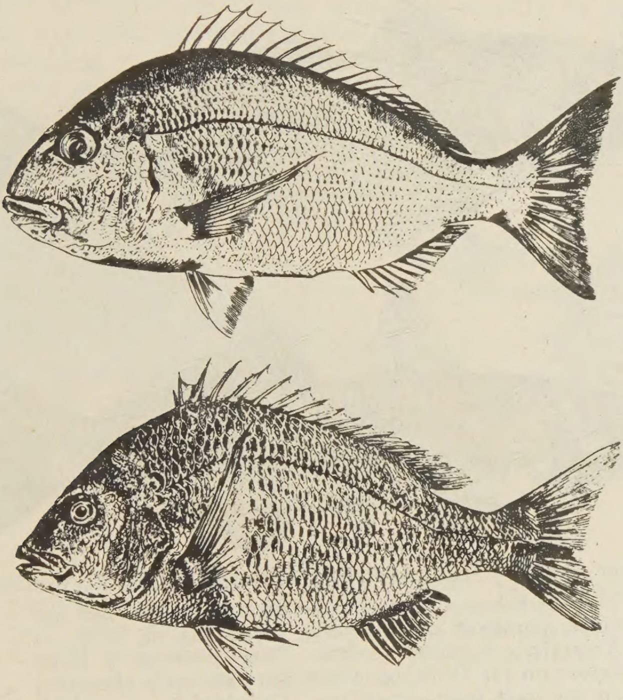
PEARL PERCH *(Glaucosoma)*

This large edible fish and another closely-related species are very abundant in open waters of Northern Australia. First-class food fish, attaining a large size. Caught by line, and by meshing and trammel nets.

Then we have also at one point just within the tropical area of the north-west one of the principal gathering-places of the humpback whale in the world.

In some instances these fisheries have already been developed —notably in the case of pearling, the taking of trochus and green snail, trepang, and the capture of the humpback whale—but on the whole these great fields for enterprise are still waiting to be conquered, though they form probably the most prolific tropical fisheries province in the whole world. To those who are familiar with the history of fisheries development in various parts of the world, it appears almost incredible that this vastly rich area should have remained for so long in this neglected state, and by a people who are certainly not lacking in energy, enterprise, and resourcefulness. I take pains to mention these three qualities because it is quite a common thing in Australia for us to upbraid ourselves, so to speak, for our failure to turn our poorer lands to better account; yet anyone who is familiar with the course, and the extent, of the utilisation of our land must frequently have been struck by the heroic efforts made and the great resource shown in endeavouring to get the very best possible return from, frequently, the most difficult of pastoral and agricultural areas. But, as I have before suggested, the fisheries field has largely been a terra incognita to us in the past, and this has accounted for our lack of understanding of resources which have been at once apparent to Asiatic peoples.

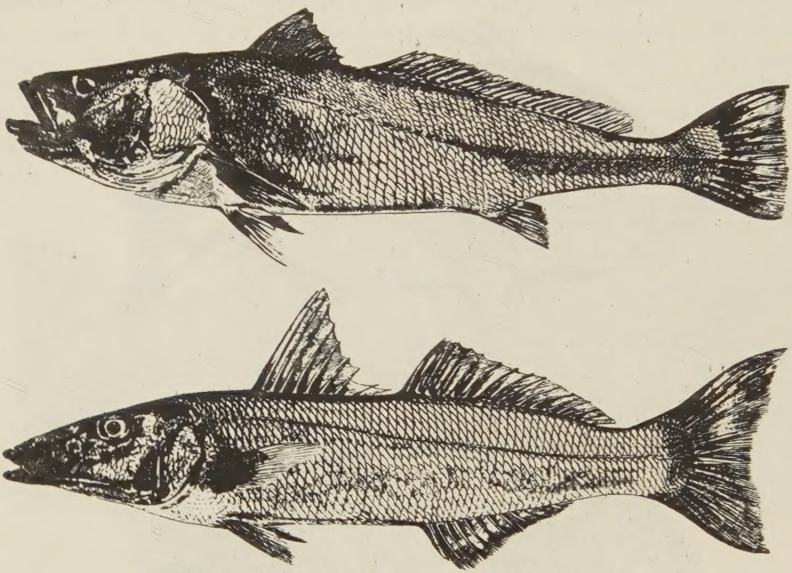
We have spent literally millions of money in our efforts to conquer the wilderness, and no problem was too hard for its solution to be attempted. One could wish that we had shown the same prodigality in exploring and in testing our marine resources. If only a small part of the money uselessly expended of works like the great unused meat works at Carnarvon, in Western Australia, had been wisely spent in fisheries investigation and development, we would now have established on our tropical coastline undertakings of great magnitude, adding much to Australia's wealth and, incidentlly, distributing population in ports where we cannot otherwise possess it.



Upper: TARWHINE. Lower: BLACK BREAM.
Both of these and some allied kinds are very abundant in all northern waters. The Tarwhine attains to a large size in these waters. Caught by net and fixed trap.

Commercial Fishes.—As the mean temperature of the coastal waters in our tropical regions ranges from about 75° F.

to as much as 85° F., and is almost uniformly warm throughout the year, the investigator is not surprised when he finds that the fish fauna is, to a very large extent, a kind of overflow or extension of the Indo-Malayan fauna or of that of south-eastern Asia. I refer here to main types, of course, and not necessarily to individual species, although many of these are quite identical. It is of special moment for me to point this fact out, however, as it renders it the more easy to speak of the economic value of a number of them that are already so well known in fisheries development elsewhere. But a little distance to the north of these Australian waters, in the Malayan region, most important and quite ancient fisheries exist for the capture and treatment of just the sort of fishes and other aquatic animals which are to be found in such abundance here.



Upper: JEWFISH *(Sciaena)* Lower: WHITING *(Sillago)*

The Jewfish and several allied kinds of edible fish are quite abundant over several thousands of miles of Australia's tropical coasts. They prey to a large extent on the Whiting, which are extremely abundant on the vast sandy stretches. Caught by line and by hauling and meshing nets. The Jewfish reaches 5 to 6 feet in length.

My personal investigations into these Malayan fisheries for the British Government in 1922 and 1923 brought me into possession of a very close insight into their value and potentialities, and the better enabled me to see the prospects of developing the allied fisheries of near-by Australia. A little later on I deal with the prospects of building up a great export business from the coasts of tropical Australia to the ports of the Middle East and to China and Japan; so, with a view to assisting those who may enter into this business (particularly with that great trade metropolis Singapore), I have included here and there certain Malay names by which the fishes are known to the men engaged in the fisheries. It is hoped that this may facilitate business conversations.

Among the larger edible fishes are various species of the greater scombroids like the Spanish Mackerel, *Scomberomorus;* one of our finest edible kinds, known so favourably in Singapore and Batavia as *Ikan Tenggiri.* These fishes occur in vast shoals, and are readily taken by hook and line, by drift nets, and by fixed traps of large size. They attain commonly to four feet in length, and lend themselves well to treatment by freezing, drying, pickling, or smoking. Other large mackerel-kind also occur in very great numbers. Some of the species are small and specially suitable for pickling or drying, while others of the Tunny type (Mal. *Tongkol)*, or the large Horse-Mackerel, *Sarda* are large enough to be handled separately for freezing, canning, or pickling. Among other large pelagic fishes that may be mentioned as occurring in great abundance over several thousand miles of coastline are the great Kingfish, Seriola, large "Barracuda" Pike[1], *Sphyraena* (Mal. *Alu-Alu)*, great Long Toms, *Tylosurus*, and the widely-distributed Dolphin Fish, *Coryphaena*, well known in Honolulu and in Japan for its high edible qualities. Several kinds of large Trevally, *Caranx*, are also very abundant over practically the whole distance from Shark Bay all the way round to Maryborough.

A PARROT FISH.

Many kinds of parrot fishes inhabit Australia's tropical reefs in prodigious numbers. Some are of very large size, and are edible fish of high quality. Caught by hook and line, meshing and trammel nets, and fixed traps.

The perch-like fishes occurring commonly on our tropical coasts include the great Queensland Groper (often called Black

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[1] Not the Barracouta, *Thyrstes*, of our southern waters.

Cod, but not to be confused with the Black Rock Cod), a magnificent fish, often reaching 400 pounds in weight, and occasionally even more. A number of other serranoid perches of large size and wide distribution are also found in abundance about reefs and rocky shores throughout this region. These are of the type generally known in Singapore, Batavia, and Macassar under the name of *Kerapu*. They are all first-class edible fish. There is also the well-known Giant Perch (one of the kinds of fish known in Queensland as Barramundi). This is found throughout the whole region (Mal. *Siakap).* Among the sea perches occurring commonly are several of the genus *Lutianus*, to which belongs the widely-known and highly-appreciated *Ikan Merah* or Red Fish of the Middle East.

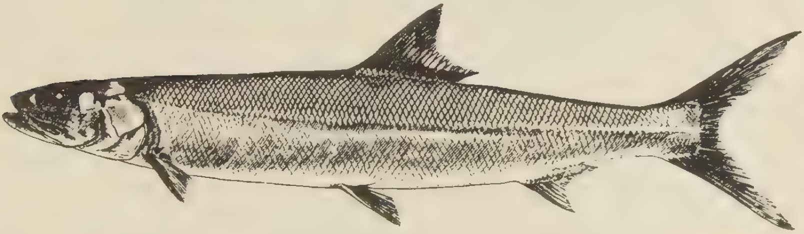
The herring family is well represented by some giant species and many small kinds. The great Milk Fish or Salmon Herring. *Chanos* (Mal. *Bandang*) the Australian Tarpon or Ox-Eye. *Megalops* (Mal. *Bulan-Bulan*) the Giant Herring, and the Dorab or Wolf Herring, *Chirocentrus* (Mal. *Parang-Parang*) are all well-known edible fishes among the large species, while among the smaller kinds are many Sprats, Sardines, and Anchovies well suited to drying and canning operations.

Mullets, *Mugil* (Mal. *Belanak* and *Anding*) and Garfishes of many species are very abundant in all our tropical waters, while Whiting, *Sillago*, swarm on the beaches, along with several species of Flathead, *Platycephalus*, Great Eels of the "Silver Eel" type, *Muraenesox*, up to six feet in length, and a wide variety of the muraenoid eels or Morays are also abundant —the first-mentioned in open waters and the second among the reefs. A useful fish is the Threadfin, *Polynemus*, of which one kind is similar to the valuable *Kurau* of Singapore. Two kinds of Butter-Fish, *Scatophagus* (Mal. *Ketang*) and Bat Fish (Mal. *Daun* and *Tudong Periok*), are found in great numbers everywhere.

Among the well-known snapper and bream family there are a considerable number of first-class edible fishes; some of quite large size, such as the Emperor Bream, the Yellow-mouthed Snapper, *Lethrinus*, and the Tarwhine (Mal. *Beras-Beras*), which, though a comparatively small fish on the New South Wales coast, attains to several pounds' weight in our tropical waters.

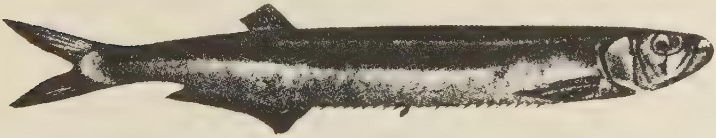
One might mention quite a large number of other kinds of commercial fishes readily available for capture by one or other of the methods to be mentioned later, but I will close this detailed reference to specific kinds by some notice of the Sharks and Rays. Practically all of these are edible fishes, though we in Australia prefer to regard them as inedible. In recent years a large number of some of the smaller sharks have been figuring in the markets of Sydney and Melbourne, while several kinds of the valuable rays have been regularly brought in and sold under the generic trade name of "skate" applied to all such species in the British markets. There are very many kinds of these sharks and rays in our tropical waters—some extremely abundant and a number of great size. I believe that there is a very great future for the use of this class of fish—more particularly in its dried form for export, and the export of shark fins to the East. At the present time sharks and rays are looked upon, not only

SPRATS, Sardines, Herrings, and Anchovies of several kinds swarm in the tropical waters of Australia. Suitable for canning, pickling, drying, etc.



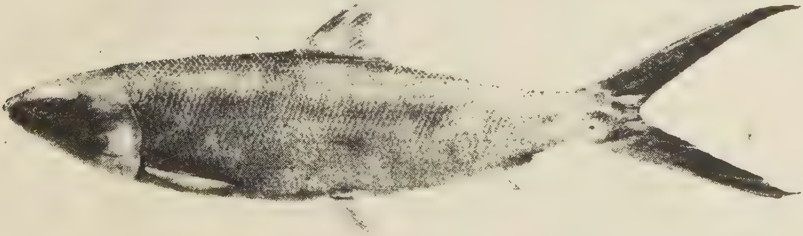
GIANT HERRING *(Elops)*

This food fish is very common in all open and reefy waters around the northern half of Australia. Already widely known as a good edible fish, attaining 4 feet in length. Caught in fixed traps and nets.



THE GREAT WOLF HERRING *(Chirocentrus)*

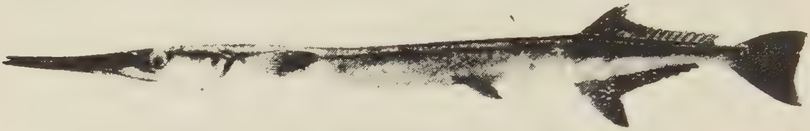
Very abundant in open northern waters. Attains a large size and is well known as a first-class food fish. Caught in fixed traps on open reefs and in meshing nets.



SALMON HERRING or MILKFISH *(Chanos)*

A first-class edible fish, common in tropical waters, well known in Singapore and other Eastern markets. Reaches 4 feet in length.

in Eastern markets but in many other places, as good edible fishes, whether sold dried or fresh, and there would be no difficulty in marketing everything in this line that we can possibly export, however much that may be.

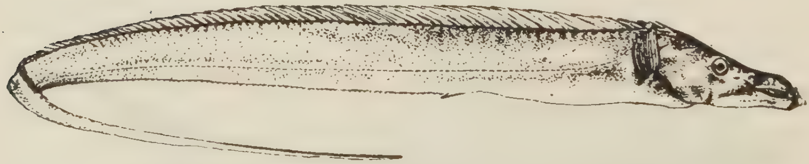


LONG TOM or GAR-PIKE *(Tylosurus)*

Several species of Long Toms are abundant in northern waters. Good edible fishes, well known in all markets. Attain to 4 feet in length.

BUTTER FISH *(Scatophagus)*

Two kinds are very abundant in Australia's tropical waters. Both are well known in markets of Middle East. Good edible fish.



SCABBARD FISH or HAIRTAIL *(Trichiurus)*

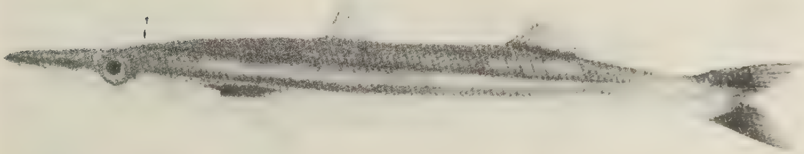
This and an allied species are abundant in all open tropical waters. Well known as fine edible fish, reaching 4 to 5 feet long. Caught by line, nets, and fixed traps.

In this section I have been dealing only with edible products, but there should be a fine opportunity for the development of a great shark industry as a subsidiary to other fisheries —handling, in addition to the dried flesh beforementioned, shark skins for leather, dried meal, oil, etc.—on various parts of this long, prolific coastline

Methods of Capture.—Almost every known method of fish capture may come into use over such a vast stretch of varied coastline. Free-swimming fishes would be taken by trolling, by drift-nets, and by anchored meshing nets. Bottom-frequenting kinds may be taken by handline, by long lines baited with many hooks, by trammel nets, and, in areas free from obstructions, by hauling or seine nets. On the whole, however, these waters lend themselves peculiarly to the various types of set traps such as are found in such great numbers throughout the Malay Archipelago for the capture of the same or closely-allied forms of fish life. Such traps are set on shallow reefs or on banks at the mouths of bays and estuaries; long wings or leads guide the fishes into the drum of the trap as the tide rises or falls, or as the fish are coasting along the reef to some natural outlet or along the shoreline.

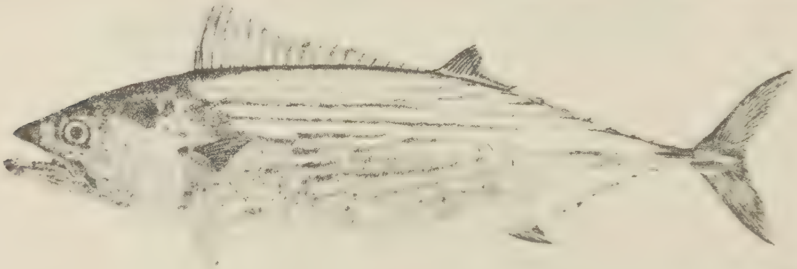
COMMON SEA MULLET *(Mugil cephalus)*
This and other kinds of grey mullet are distributed widely and abundantly over tropical coastlines of Northern Australia. Caught by net and fixed traps.

GARFISH *(Hemirhamphus)*
The largest garfishes of Australia are found in great profusion along the tropical coasts. Widely known as among the world's best food fishes. Caught by nets and fixed traps.



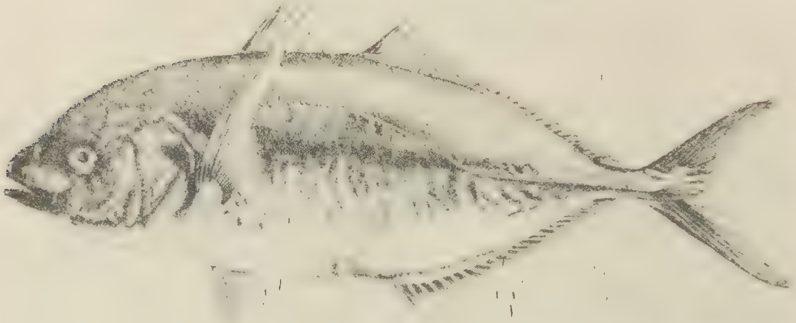
BARRACUDA PIKE *(Sphyraena)*
These short-finned pikes attain in some species to from 4 to 6 feet in length in Australian tropical waters. Good edible fish, in great demand. (Not to be confused with the Barracouta). Caught with trolled lines and nets.

The presence of protecting coral reefs over a great deal of this area allows of the erection of these stake nets or traps where otherwise they would be liable to rapid destruction on an open sea face. On the Great Barrier Reef itself and on its myriad subsidiary reefs this type of fishing particularly lends itself to a highly economical practical use, as it necessitates the minimum of labour with the maximum of execution. Two men in one stout boat may attend to quite a number of such constructions at each tide. The capital cost of these great traps is comparatively low, and the cost of maintenance throughout one season is usually small. In some regions of our tropical coastline which experience a "cyclone season" the cost of maintenance would be somewhat higher. Other types of fishing gear as commonly used by the Chinese fishermen—especially the Hohkiens—would also lend themselves to economical commercial use, if in the hands of Asiatics who are familiar with them. This would include many forms of pocket like, and scoop nets, lifting nets, small traps, casting nets (especially for bait), and the extraordinary form of long line or bultow known on the Malayan fishing grounds as the *Rawai*, having hundreds of



HORSE MACKEREL *(Sarda)*

This and other large mackerel or tunny kind are abundant in open tropical waters. Good food fishes. Caught by trolled lines, nets, and large fixed traps.

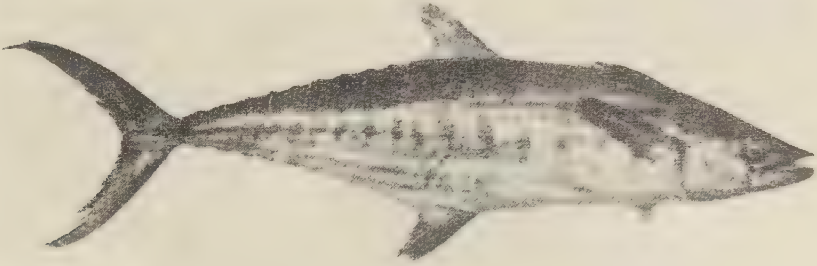


TREVALLY *(Caranx)*

Many kinds of Trevally occur in very great abundance almost everywhere in Australia's tropical waters, from a few inches to 3 feet in length. First-class food fishes, with a great world demand. Caught by line, net, and fixed traps.

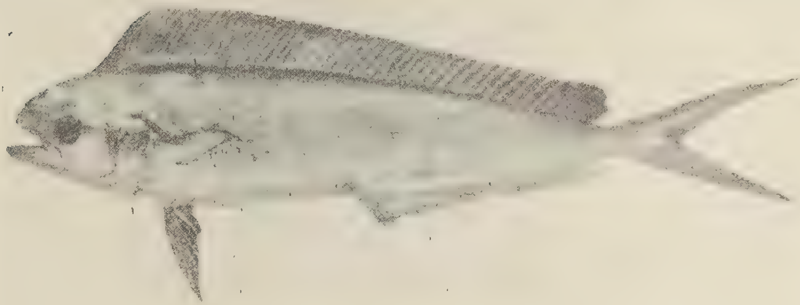
baitless barbless hooks attached, and specially aimed at the capture of sharks, rays, and the great silver eels.

Crustaceans.—Australia's tropical coasts are very rich in edible crustaceans. Crayfish ("Lobsters"), *Palinurus* (*Senex*) of large size and of fine edible quality abound almost everywhere throughout the whole region. In all estuarine waters the great Mangrove Crab, *Scylla*, is very abundant. This is one of the best commercial kinds in the world, and attains to a large size. Quite a number of other edible crabs, suitable for freezing, canning, or drying, are found distributed throughout the region. Prawns, *Penaeus*, are also extremely abundant (as they are throughout the whole of the Indo-Malayan region), and are available for economical capture and preparation for market in various ways. There is also a large Long-armed Shrimp, *Palaemon*, already so well known in other fisheries fields.



THE GREAT SPANISH MACKEREL
(Scomberomorus)

The open seas along the tropical coasts of Australia are teeming with several kinds of these large food fishes, which are among the very best of the world's edible kinds. Already marketed and highly valued in many countries. Attain 4 feet in length. Caught by line, meshing net, and fixed traps.



DOLPHIN FISH *(Coryphaena)*

Fine edible fish, attains 6 feet in length. Captured in large numbers by trolled lines. Very abundant in tropical waters, at sea.

In this section of fisheries development alone very extensive local industries could be set up here and there along our northern coasts.

Shellfish.—I restrict this trade term here to various mollusks. The trade in pearl shell is already well known at Broome, Thursday Island, and, to a lesser extent, at Darwin. Recently new discoveries have been made on the North Queensland (Barrier Reef) coastal grounds, and there is no reason why much larger developments of this valuable fishery should not result from a system of careful fisheries investigation throughout the known habitat of the pearl shells in Australian waters—reaching from Shark Bay on the west to Townsville on the east. Good reef oysters, suitable for canning and drying, are abundant in many parts, while the well-known Trochus or Button-Shell, around which a large industry has already been built up, is to be found in many localities in which it is not yet commercially worked, because of the absence of the right form of labour. The great commercial Green Snail, or Turban Shell (used for button-making), also abounds in reefy areas over much of the coastline. Many other shells suited to button-making or other commercial uses occur in great abundance throughout our tropic waters. Among these is the Window-Pane Shell, *Placuna*, now used largely for electric light fittings.

COW-TAILED STINGRAY *(Pastinachus)*

This and other stingrays occur in great numbers in all our tropical waters. Great demand for dried flesh. Skin widely used for best shagreen work. Commonly reaches 4 feet wide.

Mention should be made also of the squids, which are so abundant in all northern waters. These figure to a very large extent already in all Asiatic and many European markets. A large export business might be built up in these "cuttle-fish" n the dried form. The markets of the Middle East know them as "*Sotong*."

Beche-de-Mer or Trepang.—A considerable trade already exists in this commodity—the commercial name for the dried sea-cucumbers or sea-slugs, **Holothuria**—and, with a fully-developed fishery region, a great addition to the annual output would result.

Turtles.—Edible Turtles are freely distributed over several thousands of miles of our tropical coasts. Barring the coasts of the Malayan countries immediately to our north, no area of the world produces them in such profusion. Great developments could be undertaken while safeguarding the maintenance of the fishery in many parts of our northern coastline. Turtle soup, canned turtle, dried turtle flesh, and tortoiseshell—taken from the Hawk's-Bill Turtle, which is also present in large numbers everywhere in the same localities—might readily form the basis of a large industry.

EAGLE RAY *(Myliobatis)*
Attains large size. Highly abundant in all northern Australian coastal waters. Much sought after in Eastern markets. Good edible fish.

Dugong.—The great Dugong, *Halicore*, is quite abundant in suitable localities in many northern Australian waters. While taking every care to preserve the species, a large fishery, utilising the flesh for canning and drying, preparing the skins, and extracting the valuable oil, might be built up along with other fishery industries. I would emphasise the last five words here. There are many fishery industries that are contributory to the main ones associated with fish capture. That applies, for instance, to shark industries, which, though unlikely to pay commercially by themselves, may be highly lucrative when developed along with other branches of the fisheries.

Other Products.—Coincidently with the opening up and development of the main fisheries of the northern waters would be many subsidiary industries, such as have been in existence for ages in other parts, notably in Asiatic countries. Among these may be mentioned a trade in Fish Skins of various types (apart from shark skins), Fish "Maws," or sounds—in which there is a large trade in Singapore, Batavia, and Hong Kong—Edible Seaweeds, Sponges, and "Sea Grass."

Whales and Whaling.—No account of the fisheries of tropical Australia would be complete without mention of the important whaling centre at Norwegian Bay, a few miles to the north of Point Cloates, on the north-west coast. Here there is a highly-successful shore station, now in the possession of the Australian Whaling Company, from which the pursuit of the Humpback Whale has been carried out for several years past. The whales are captured by modern whale chasers or gunboats within a few miles of the station, and are then brought in to be treated at the station, which is completely equipped in a modern manner for the flensing of the carcases, for the extraction of the oil from the blubber and carcases, and for the manufacture of meat and bone meal. This concentration of these whales at a point inside the tropics in such large numbers is one of the most remarkable occurrences in the world. The season lasts from June till October, the whales travelling first north, and then (about August) turning to the south. A small number of Blue Whales and of the Black Finback also appear in these waters, but they are insignificant in number compared with the Humpbacks. Last year no less than 1,036 whales were taken at this station by four chasers. With the permanent establishment of the whaling industry in those waters by Australians, no doubt other forms of fishery enterprise would also be undertaken there.

SHARKS of many species are particularly abundant in all northern open and estuarine waters and around all reefs. They range from 3 or 4 feet to 20 feet in length, and are of prime commercial value, whether as edible fish (dried), for their skins, for fins, and for oil.

Prospects of Fisheries Development in Tropical Australia.—I have discussed the possibilities of fisheries development in our tropical seas, and have gone into some detail as to the principal kinds of fishes and other organisms upon which extensive industries might be founded. And now it is necessary to say something of the prospects, or the probabilities, of full development within a reasonable time by Australians. I have given the subject much thought for many years past—and the most intensive study since my sojourn for some time in similar waters in which the fisheries of the same types had already been developed by an understanding Asiatic population.

I would like members of the Geographical Society and of the general public to understand that whatever conclusion has been come to has not been arrived at hastily or with any want of consideration for our great problems surrounding white settlement in Australia. Nor have the main arguments for our White Australia policy been lost sight of for a moment. But I am constrained to say that, whatever we may do in the way of setting up large marine industrial concerns here and there—as at various points on the Great Barrier Reef—we will do but little towards the full potential development of these rich regions without bringing about such a considerable modification of our White Australia policy as will allow of the settlement of large numbers of Asiatics on these northern coasts.

BLUE SWIMMING CRAB *(Portunus)*

Several commercial kinds of large swimming crab are very abundant throughout Australia's tropical waters. The one above-figured is common everywhere, and is of a type of which millions are canned elsewhere (Japan and United States) and imported into Australia.

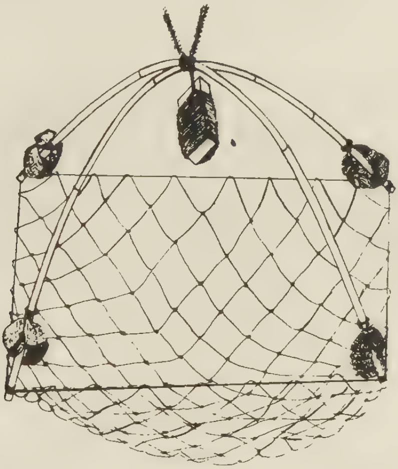
Without the assistance of these people, who understand every stage of the development of such areas and are prepared to undertake the arduous labours (under the most difficult conditions) connected therewith, I venture to say that within a space of twenty years we will still be talking of the possibilities and not of the practical development which has taken place! With the planting of a strong, hardy population of, say, Hohkien (Chinese) fisherfolk in this region, however, I think it is not difficult to forecast very great developments indeed—so great that in the same space of twenty years we may find established a long chain of fishing villages aggregating tens of thousands of fine, sturdy, law-abiding Chinese citizens whose labours will be adding vastly to the wealth and importance of the Commonwealth of Australia, while furnishing a population in parts which, in my opinion, will otherwise remain empty desert places for as far ahead as we can see.

GREAT MANGROVE CRAB *(Scylla)*

Very abundant in all estuaries. Grows to a large size, and is much sought elsewhere. Suitable for canning and freezing. Caught in small traps.

I expect to be taken very seriously to task for making such a frank statement of belief when it comes into conflict with one of our most cherished ideas. If I had space, however, I would even be prepared to challenge here the views commonly expressed in regard to the White Australia policy, as I believe that these are not the basic ideas behind such a policy, which originally had nothing to do with a truly "white" Australia—that is, an Australia free, let us say, from Asiatics—but rather that the whole scheme was founded and erected on purely economic grounds connected primarily with wages and the standard of living. With that, of course, I have every sympathy and a keen desire to see that nothing is done that will upset it; but I believe that the development of the northern coastal fisheries in the way suggested may be achieved without in any way upsetting our present social or industrial systems.

In any case, and whether we like it or not, I can see no alternative to a persistence of the present almost empty coastline over thousands of miles of tropical Australia (excepting the southern half of Queensland, where land industries also have a chance of developing), except by a modification of our migration policy in the way indicated. If, nationally speaking, we are content to leave it undeveloped and gaping for population, then I have nothing further to say; but I expect that such will not remain our desire. Of course, it is understood that special industries, such as whaling, where large vessels are employed for a season in each year, are not dependent upon permanent settlement of the type indicated.



TRAP-NET FOR MANGROVE CRAB.

This is known throughout Middle East by Malay name of Bintoh. Set in large numbers along shores in estuaries. Bait is suspended where rolled-up line is shown in drawing. Crabs crawl on, and legs slip through twine meshes. Thousands per day are caught by this means everywhere in Malaysia.

It may be said by some critics that what the Asiatics can do, so can we. Within certain bounds that will be agreed to; but in highly-specialised avocations which are unpleasant or unattractive to our people, and which in addition are to be carried out under difficult or even distressing conditions of climate, there is no reason to think that our people will show any more interest in the future than they have in the past—rather the other way, in fact.

Secondary Industries.—The introduction of large primary fishery industries spread over thousands of miles of coastline, and the consequent additional population, would provide scope for the growth of many attendant secondary industries, while tropical farming on small holdings—a thing quite impossible at present, or at any time unless the consumer is near at hand—would be a practical possibility in many places. There is no good reason why we should not use the product of the Trochus fishery in Australia and of the Green Snail for button-making, etc., and many such developments might result from an intensive attention to the planting of fishery industries in the north.

Markets for Fishery Products.—In the development of our northern fisheries I have indicated that there would be freezing of the larger fishes and crustaceans, canning of many kinds, drying, pickling, etc. Northern Australia is so geographically situated as to be almost within coo-ee of the Middle East and the whole of the Malayan region, as well as on the track of vessels sailing to China and Japan. In these countries (including India) we have at least 800 millions of potential fish-eating customers within a reasonable distance. The market for the larger frozen fish would probably be in Australia itself; also for much of the canned product. (Freezing and canning would be done by Australian companies supplied by the labours of Asiatic fishermen, according to my scheme.) As regards dried fish, we have an atmosphere and tropical climate admirably adapted for rapid dehydration of fish under natural conditions, with the right kinds of fish and crustaceans, needing no introduction to prospective millions of consumers. My own personal official investigations indicate that Singapore alone could absorb the whole of our possible output of dried fish products for many years to

TIGER PRAWN *(Penaeus)*

Prawns of the genus Penaeus are very abundant in northern Australian waters, and attain to a large size (up to 12 inches). The specimen illustrated was 13 inches long. In estuarine waters also a large shrimp (*Palaemon*) also abounds.

come—not merely for use in that city or in Malaya, of course. Singapore is an immense clearing-house for such food products. All of the other products of the fisheries that I have mentioned during the course of these remarks are already well known and have their regular markets.

It should be remembered also that the fishing communities themselves provide some market, as they depend primarily for their food supply on what they take from the water, supplemented by rice and flour. Livestock, such as pigs, and also ducks, are supported largely on the products of the fishermen's labours.

CONCLUSION.

In these few pages I have endeavoured to show that, while geographical controls make Australia's tropical and central areas in the main, impossible of intensive settlement,, the development of the fisheries of the waters bordering those lands falls within a different category. The key to the future is held to be a strong policy of fisheries development coupled with a sufficient modification of our immigration policy to allow of the ready introduction of certain Asiatic skilled labour familiar with all forms of tropical and reef fishing. It is considered that only by such means shall the wide, empty stretches of the coasts of the northern half of Australia be made productive and able to carry any considerable population. While this would be largely Asiatic in origin, it would support all through a fair percentage of Australians (white), who would utilise the products of the fisheries.

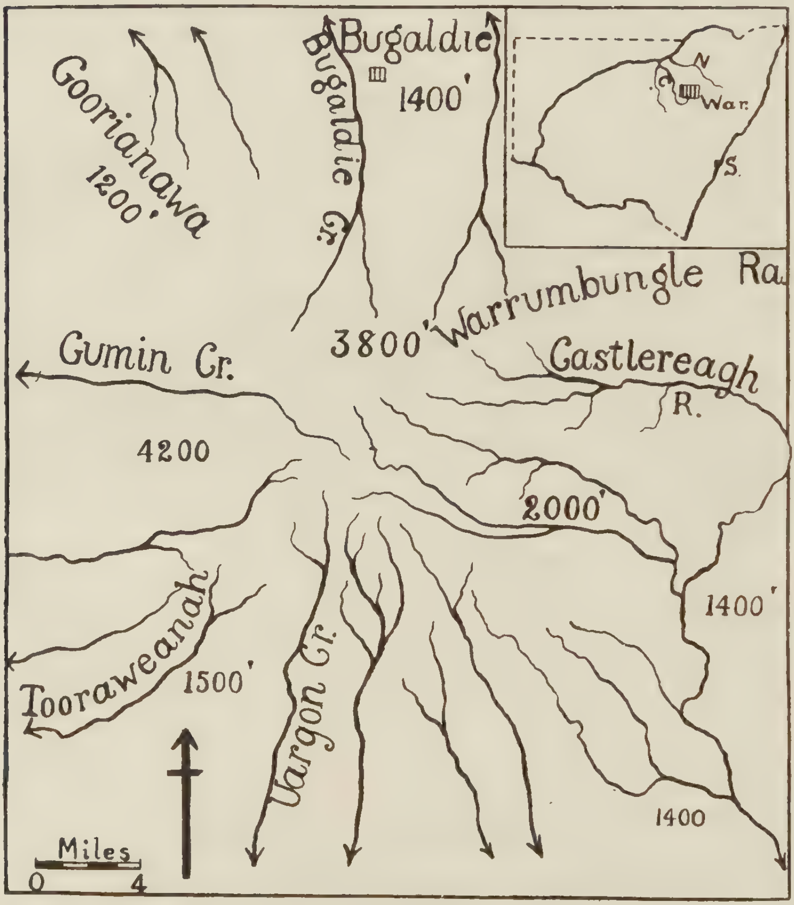
It is hoped that the interested Governments of the States of Western Australia and Queensland, and primarily of the Commonwealth, will allow no prejudices of the past to stand in the way of a calm, dispassionate consideration of the problem - which is one of the most serious that Australia has been faced with.

The Bugaldie District, Warrumbungle Mountains

By MARJORIE LAWSON and HELEN STANLEY.

The Warrumbungle Mountains lie some 300 miles north-west of Sydney between the towns of Gunnedah, Dubbo, Mundooran and Baradine. The region was first discovered by Evans in 1818. The rich valleys of the Warrumbungles were later taken up in large holdings. A few of the original stations still remain, e.g., Goorianawa and Yearinan but the majority have been cut up for closer settlement. The region has been investigated geologically by Professor Sir Edgeworth David, Dr. Jensen and Messrs. Card and Dun, to whose accounts of the region we acknowledge our debt in the writing of this paper.

THE WARRUMBUNGLE MOUNTAINS.—As the district investigated is only a very small portion of the large unit of the Warrumbungles, it can scarcely be adequately described without



Map of the Warrumbungles, from the stereogram by H. I. Jensen. (P.L.S. N.S.W., 1907.)

some general account of these mountains. The Warrumbungles are roughly circular in shape with a radius of about 30 miles. They consist of a central rugged mass rising in places to 4000 feet, falling off towards the periphery to about 1000 feet. From the core radiate streams flowing either to the Namoi in the north or to Castlereagh in the south. The streams in their upper courses flow in narrow precipitous valleys fed by permanent springs. The valleys widen out considerably as they recede from the centre.

The beginning of the Warrumbungles goes back to Cretaceous times, when Permo-Carboniferous and Triassic Deposits were raised above sea-level and subsequently reduced to a peneplain at the present 2000ft. level. Volcanic activity commenced in the early Tertiary period. The lavas built up a central mass over 4000 feet high. Later flows filled the valleys. One of the most interesting geological features is the Diatomaceous earth deposits which are found at Wantiallabah Creek, Paddy McCulloch's Mountain and Chalk Mt. These deposits are generally interbedded with trachytic rocks.

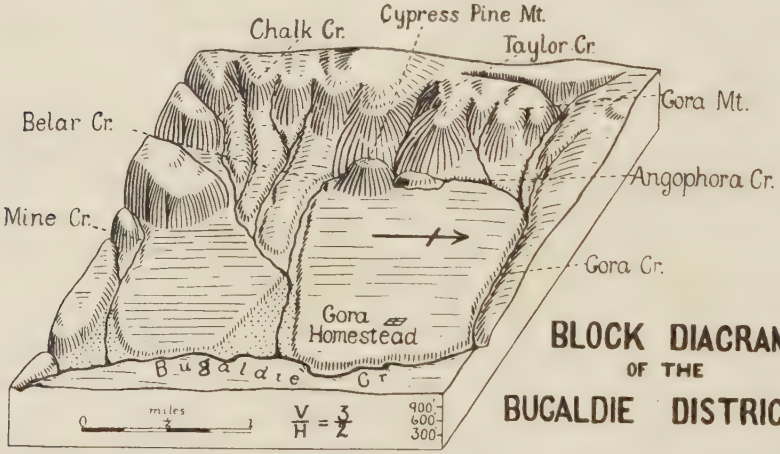
THE BUGALDIE DISTRICT.—The district investigated includes a portion of the left bank of Bugaldie Creek, one of the radiating streams flowing north from the core of the Warrumbungles to the Namoi. The river in this region occupies a small canyon at the 1230ft. level in a wide flat-bottomed valley about 4 miles wide.

Geology.—The main geological division lies along the junction of the valley floor and the walls, which rise to 1,550ft. The highlands which mark the boundary of the flat-floored valley owe their presence to a capping of hard aegerine trachyte. This hard volcanic rock forms a protective layer to a stratum of soft argillaceous sandstone. Beneath this is a layer of coarse-grained Triassic Sandstone. Such is the succession of formations in the vicinity of the Gora Homestead, which lies on Bugaldie Creek some two or three miles from the township. At Chalk Mt., however, the southerly limit of the area investigated, the succession is somewhat different. Here the volcanic capping is coarser grained and is more like a dolerite. Beneath this is a stratum—about 12′ thick—of diatomaceous earth. Beneath this is another layer of dolerite and beneath this the sandstone. This difference in the volcanic cappings in close juxtaposition and probably of the same age, is indicative of a differentiation in flows probably from the same vent in the period of vulcanicity.

A few words may be said here about the "chalk deposits" as they are commonly called, and the following description is an abstract from the paper by Messrs. Card and Dun on the Diatomaceous Earth deposits of New South Wales. This deposit is made up of an infinite number of diatoms. These microscopic plants have a range from Carboniferous to the present time and thrive in both fresh and salt water. When they collect, their carapaces form a solid mass of chalky material which is generally allied with carbonates of lime and magnesia. These deposits are generally found in close proximity to igneous rocks and Professor David thinks this is significant. He remarks that "the superheated water flowing from hot-springs and the lavas themselves during the eruptions would be certain to carry more or less silica in solution, and the high temperature combined with the dissolved silica, would probably render it a very favourite medium for the development of diatoms to the exclusion of most other kinds of plants."

The "chalk" can be put to several different uses. It makes a good polishing powder and can be used as a basis for soap. Also its property as a non-conductor of heat makes it suitable for boiler and steam pipe coverings.

The "chalk" mine on Bugaldie Creek consists of a layer about 12′ thick which can be easily worked by horizontal shafts. It can be seen from a distance of some miles as a kind of white gash high up in the mountain. It was first discovered by rabbits who found it easier to burrow in this soft earth than in the hard dolerites and sandstone. At present only the northern part of the mine is being worked as the eastern part is too damp. But a tunnel is to be cut through the chalk to enable an air draught to pass through. The earth is rich in fossil fish and rushes, which give a very weird effect when viewed in the pure white walls and roof of the mine.



BLOCK DIAGRAM OF THE BUGALDIE DISTRICT

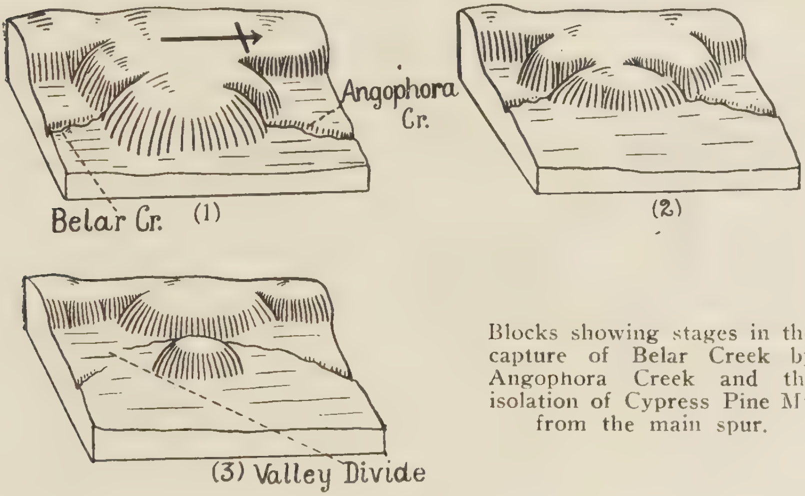
The valley floor consists of recent reddish silts with a veneer of quartz pebbles. In the main creek bed the silt is fine and black. Thus the present river system has cut down through the volcanic capping and Triassic sandstone to a valley 300′ deep and about 4 miles wide

Topography.—The main topographic features are the main "misfit" valley and a number of steeply flowing tributaries which are cutting up the valley walls.

Bugaldie Creek.—This, the main stream, rises some seven miles from the township of Bugaldie in the distant pile of Yahringerie and the Wheoh. The present water course occupies only a small canyon 30′ wide in a valley 4 miles wide. It is thus a good example of a misfit and is certainly not the stream which cut the wide valley which it now occupies. The river, when it is running, winds about between a stately avenue of she-oaks to the dimly distant Pilliga country, falling only about 20′ in the mile. Hence it carries on a constructive rather than a destructive course and acts as a check on the down-cutting powers of the tributaries.

The Tributaries.—The tributaries all have an average fall of about 100′ per mile, though most of the fall is accomplished in a very short distance in their upper courses. The large boulders often more than a foot in diameter, which are strewn along their courses are ample evidence of their erosive and transporting powers.

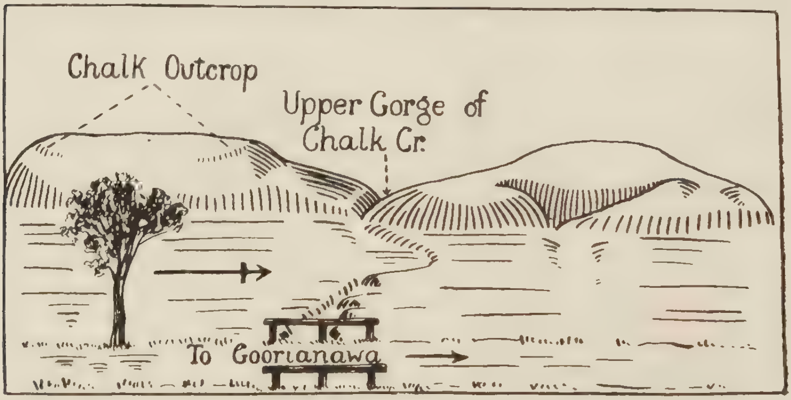
(a) Chalk Creek.—This creek is the longest of the tributaries. It rises at about the fifteen hundred foot level where it has the typical V-shaped gorge and flows north-east to Bugaldie Creek. It receives three or four tributaries, one of which, Belar Creek will be discussed later. Beyond the 1300′ level Chalk Creek enters the main valley floor, where it has the canyon character typical of all the lower courses of the tributary creeks. The silt into which the creek has cut shows the presence of the Diatomaceous earth deposits in which it rises. The silt is of a creamy brown colour. The canyon walls show a peculiar pillar and gable formation due probably to wind erosion and sudden rains. About 300 yds. from its junction with Bugaldie Creek, the canyon topography gives place to a flat pan-like swampy region which marks the remains of an old billabong of the main stream.



Blocks showing stages in the capture of Belar Creek by Angophora Creek and the isolation of Cypress Pine Mt. from the main spur.

(b) Gora Creek.—Gora Creek reproduces most of the features of Chalk Creek. There are, however, a few features of special interest. One is a small spring which occurs below a sandstone bar at the 1340′ level. This is only a few feet square, but is rarely dry. In August, 1928, it was the only surface water visible in the region we examined. At Angophora Creek we found exactly the same formation at the same level, but there was no water near the surface. In its lower course the stream shows excellent cuttings in silt with alternating layers of coarse gravels and fine mud. Before it enters the main stream, an artificial dam has been constructed for watering the sheep of the Gora Station.

Imminent Captures Between the Tributaries of Bugaldie Creek.—There is a very interesting example of domestic piracy going on between Taylor Creek, a tributary of Gora Creek and Gora Creek itself. Here Taylor Creek will soon capture the headwaters of Gora Creek. Thus the pirate stream will practically encircle Gora Mt. As the process of dissection goes on, Gora Mt. will be cut off from the main Bugaldie spur, just as the Bugaldie spur has been cut off from the main mass of the Warrumbungles. There is another capture imminent between Belar and Angophora Creeks which will isolate Cypress Pine Mt. also from the main range.



Sketch of Chalk Creek, looking west. Note the flat-floored valley across which it flows after leaving the highlands, and of which only a half is shown in the sketch. The Chalk mine is indicated high up in the mountain. In the foreground the creek is bridged for the Goorianawa road.

Fan Deltas.—At the points where the tributaries issue from the highlands are a series of small fan deltas, seen from the main range as a definite rise of about 20′ at the foot of the hills. These deltas consist mainly of coarse gravels and mark the dumping places of the streams when their velocity is suddenly checked by their entrance into the flat floor of Bugaldie Creek.

Soils and Vegetation.—The silts of the main valley floor yield a fairly good soil and support a picturesque vegetation of many kinds of gums and wattles. The trachytes yield a reddish soil which is thickly timbered with Cypress pine, which is of little economic value. To the north is the red pine of the Pilliga country. In times of drought, the Kurrajong, apple trees and certain kinds of wattle are lopped to provide food for stock.

Economic Value of the Bugaldie Valley.—The pastoral industry is pre-eminently the industry of this part of the Warrumbungles. Here conditions are very favourable for certain varieties of merino and cross-breds. The more rugged country at the head of the valley is at present sparsely stocked with cattle. A little wheat, lucerne and maize are grown along the creek flats for fodder. Another industry, is timber-cutting at the head of the valley near Yahringerie, where the ironbarks are cut for railway sleepers. There is a saw-mill near Bugaldie Station. The diatomaceous earth deposits are also of economic importance. The earth is bagged at the mine and sent to the foot of the mountain by means of a flying fox and taken thence by motor lorry to the station.

First Ascent of Mount Balbi

By H. HAMLIN.

Leader, Whitney South Sea Expedition, American Museum of Natural History.

Volcanoes are more than mere mountains, since they hold empirical possibilities that are both interesting and important. They give probably the only actual, moving evidence of the evolution of the earth, often revealing in impressive form the pulse of inorganic life. In the Pacific archipelagoes the results of its periodic beat, speaking geologically, are seen in the island areas which derive their primal origin from submarine upheavals. They are geosynclines—arteries of weakness in the earth's crust, proved by the remarkable number and distribution of volcanoes, both live and extinct, in this region. One of the notable groups from this viewpoint is the Solomons where we find an abundance of volcanic peaks, but only two that are in a state of thermal activity; and both of them in Bougainville, the largest of the islands, approximating 110 miles in length and from 20 to 30 in breadth. With Buka, a much smaller island lying to the north (known as "Little Buka" of which "Big Buka" is the legitimate parent), it forms the geographic terminus of the Solomons equatorial extent.

The physical character of "Big Buka" is mainly mountainous having two principal ranges, the Kronprinzen Gebirge and the Emperor, which run into each other, roughly at their northern and southern extremities respectively (Fig. 1). The only flat country lies at the south-eastern end of the island. The two living volcanoes, Balbi and Bagana are nearer the western coast, which is quite exposed to the sea and, for the most of its stretch, rarely visited. The top of Bagana is very prominent, being cone-shaped, but is usually enveloped in its own smoky effulgence and atmospheric mist and rarely visible. For this reason, no doubt, hydrographic surveys do not record its calculated altitude; one might guess it at 7500 feet. The crater is very active on occasion, approach being impossible within 1000 feet of the crest. A scientific party that engaged the ascent some years ago during the former German occupation was imperiled by a sudden eruption and forced to escape. Later, two Bougainville residents, an Australian and a Japanese, climbed to nearly 1000 feet of the summit as far as the sulphur fumes would permit.

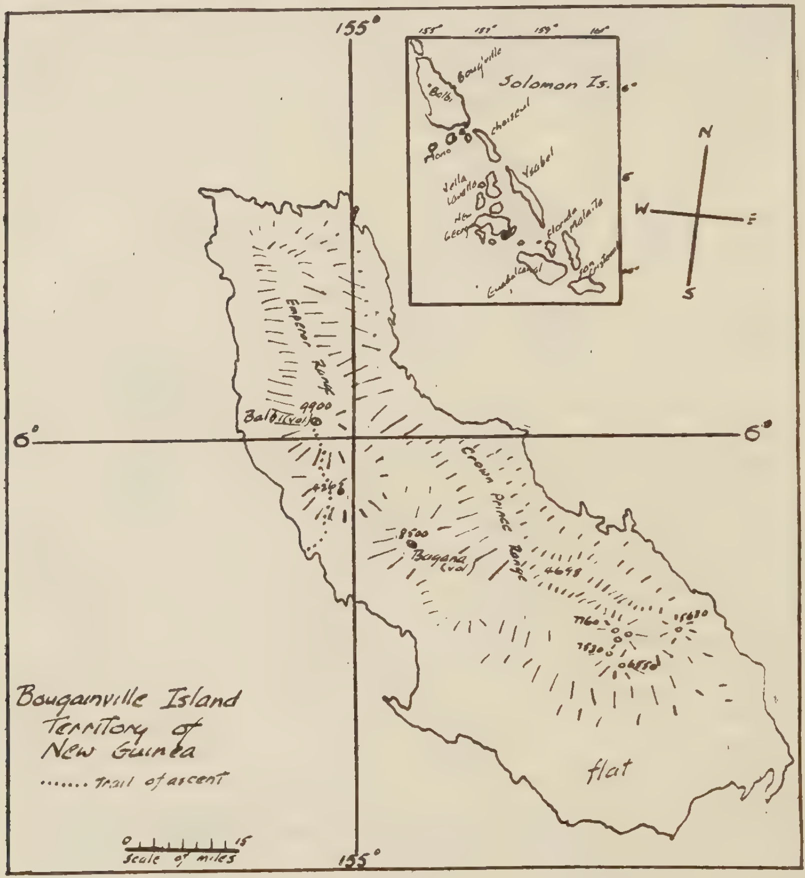


Fig. 1

Like myself, they were not prepared to record any observations of scientific value.

The top of Balbi, the larger but more docile of the two, is about five square miles in area, reckoning in the whole lava bed, hot and cold, and lies along two sides of a ridge, which is broken down on the eastern edge to form the main crater (Fig. 3). This is frequently in clear view from a few miles out at sea about sun-up when the usual blanket of cloud has been dispersed by nocturnal land breezes. I was able to make a rapid sketch of the eastern slope on just such a morning (Fig. 2). The result is very crude and only outlined the general appearance of the ridges and peaks that surround the crown. These appear to be very numerous and very steep,—like spires, presenting a formidable barrier to the climber. The few assaults that have been made upon the summit were attempted from this side, and failed, undoubtedly because of the extremely precipitous topography and the almost impenetrable patches of heavy bamboo and dense vegetation that are inevitably encountered. From the other coast, whence the climb was achieved, one cannot see the crater which is hidden by a commanding peak to the northwest. There is not such a discouraging array of cathedral-like foot-hills, and its being nearer the west coast makes the crater seem more accessible, although we traversed over twenty-five miles to cover the actual linear distance of about ten. One is rather annoyed at the aspect of a mountain like Balbi which does not "rear its mighty head above," but nestles between two others, both higher, to the north and south. Then there is a conspiracy of small mountains conjoined as foothills and these must be scaled before the objective can be approached. No ridge or continuous chain affords any kind of a lead from either coast. The difficulties entailed are obvious; judgment of direction, irregular terrain, and dense bush. In addition the concurrent change in temperature and humidity with increased altitude are not easily met when one is accustomed to see level tropical climate and concerned only with reaching the objective and returning as quickly as possible. These problems are far more upsetting than the reputed ferocity of the uncontrolled inland natives, who proved themselves quite amenable to common-sense, fortunately. In fact, without the aid of these savages the attempt would have been hopeless. They acted as trail cutters and carriers voluntarily, and mostly without sufficient food, taking what could be gleaned from the bush; and, having an inimitable knowledge of their environment, they were relied upon to select camping sites near water to keep us moving toward the crater (which they feared religiously), and for many other things.

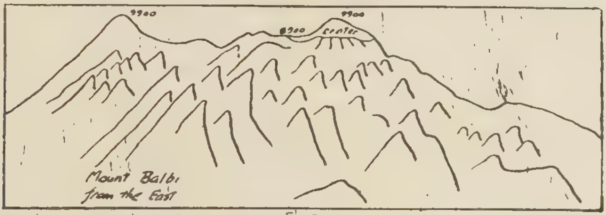


Fig. 2

The principal purpose of the ascent was ornithological with the crater as a possible objective of secondary importance. From the time we left the beach the party kept moving on and up daily, collecting along the way until we found the summit within probable reach; thus the climb accomplished its twofold purpose and proved satisfying. The brief journal I wrote during the trip contains little of scientific import, being nothing more than a cursory record based on observation alone. My only instruments were a thermometer, which was broken on the fourth day, and an aneroid barometer. Accompanying me were two Samoan assistants and a host of bushmen, who were by far the most indispensable part of the personnel.

Thursday, April 19, 1928.—The two boys and I were landed on the beach a few miles north of Cape Moltke at 9.15 a.m., and set out with the carriers hired from Piruatu (a place down the coast), reaching Pukuito village about noon. (Elevation 2000 feet.) It proved to be a much longer and steeper climb than anticipated. The inhabitants proved friendly. Riavite, the only pidgin linguist (tultul) took a lot of persuading to agree to lead us into the foothills of Balbi where we must pass through a community of four villages which have not yet seen a white man. Fortunately the same language is spoken in both places (Kiriaka), and there is no intimation of hostility except personal arguments among some of the men, mostly about women—paid for but not delivered. The Piruatu boys went back to the salt water after lunch, and we watched the ship sail south toward

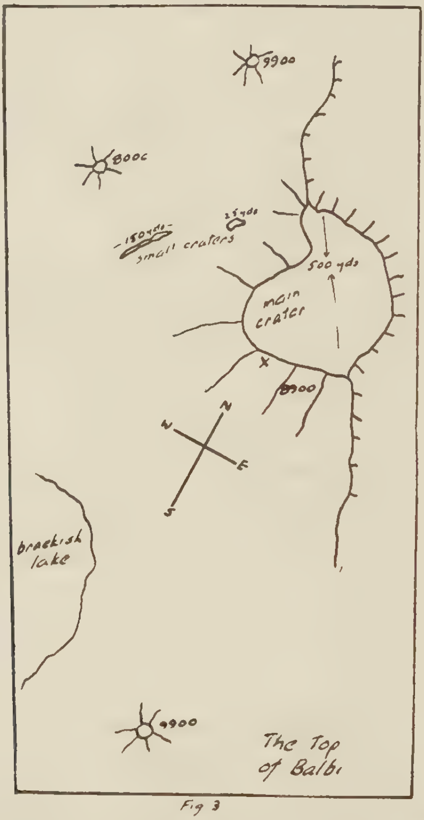


Fig 3

a safe anchorage where she will put in ten days, the time allotted for our expected return. We are camped in a fine house of the typical plaited bamboo, built to accommodate the long-hoped-for first visit of the district officer. Weather clear.

Friday, April 20.—Riavite managed to gather enough carriers and general retainers, a number of them youngsters (a good indication that they have no great expectations of trouble), so that we could depart at 11.30. Close up dark we halted to build a shelter for the night, which had to be fairly commodious to serve twenty tired people. Riavite thinks that all the bushmen will evacuate their settlements as soon as they are aware of our approach. No direct opposition insinuated; evidently fear on their part is the only possible source of a fracas. The route we followed to-day took us up and down, crossing ridges and ravines arranged sawtooth fashion; and rain made the going very sloppy and uncertain. However, a big feed and prospects of a comfortable sleep came at the end of it.

Saturday, April 21.—Broke camp about 8 and started another trek, continuing cross-drainage. The only recommendation for the trail is that it couldn't very well be better; natives usually make their roads where the walking is easiest. In surmounting a ridge, the track usually leads up a deep draw until it saddles on either hand and then similarly down the other side. We rested at noon to make preparations for meeting the untamed bushmen. Now one of the carriers comes running up with the exciting information that he has heard some of the intended hosts up ahead at work cutting bamboo. The tultul suggests that he and I try to sneak upon them and approach before they can run away so that he can "talk strong make him savvy" that the intrusion is friendly. Finding that we cannot get near without making an obvious commotion we detour with the rest of the party around the wood-cutters and sit down on the trail to wait for them. When they ambled up and suddenly found themselves surrounded by a large but very amiable crowd, they agreed to our proposal immediately. So one man went with Riavite to inform the community (Hanua) of the invasion. All this was pure luck. When we came up only about half the inhabitants had cleared out,—mostly women and children. The chief remained to receive us, which he did with a great grin. The Pukuito carriers departed shortly en masse, being uneasy lest the nearby bush villages that were truly enemies discover their presence and seize the opportunity for a one-sided fight. Only the tultul remained and after much expostulation persuaded the old chief to round up some carriers. His efforts yielded six, so we were forced to leave about half our food. At 3 p.m. we were on the track that climbs towards the volcano (known as "house belong big Master"). Another leaf shelter was built when we halted toward evening, this time at 2900 feet, not much increase of elevation considering the distance we have come from the salt water. During the night a number of the residents who had run off when we appeared came up to join the gang; evidently they had learned that we looked strange but harmless. All were inordinately curious. These fellows are small in stature but very sturdy. Their bodies are unadorned au naturel, fairly black, well-muscled, and literally covered with hair. Although they look capable of ferocity, they are much intrigued with our business and only too willing to help. The periodic arrivals accompanied by bamboo flares, hooting, and consequent conversation gave us a somewhat wakeful night. Temperature 34.

Sunday, April 22.—The meals in this camp have been cold due to lack of water; but after making the best of sardines and biscuits, we hit the trail again, which became really precipitous later in the day after about three miles of big bamboo brakes. Some of the stalks were five or six inches thick and closely enmeshed in liana. Everyone took his turn with the axe and bush knife. The safari stopped at 4.30 and the aneroid showed 5,800 feet. Now we are in the realm of nearly continuous mist, every leaf dripping cold. Heavy moss hangs everywhere and covers the ground knee-deep. Vegetation thins out as we get higher,—pandanus, giant tree-ferns, and sac-sac prevailing. The natives are always cutting the last-mentioned for food. It is the old men who break the trail; apparently they have been up this way before, but not for many years, since there is no evidence of a track. They follow drainage (we have crossed several rushing streams), and look for such things as tree stumps and other signs of former bush-whacking. Heavy rain came down as we were finishing our leaf house. Over a dozen more young bucks joined their friends in the night, bringing taro and breadfruit from the villages. Now we are about thirty. My thermometer is broken, but I should judge the air somewhere around 25.

Monday, April 23.—Began climbing at 7 with fifteen companions in a cold drizzle. The other half of the caravan will wait in camp. We crossed several streams of quick water. These often show interesting mineral deposit. I recognised copper pyrites, hematite, agate quartz, and crystals of silica and mica. Limestone is a typical stratum, and the soil mostly a volcanic tuff. Oxides of iron appear in practically all the beds; the natives mix it with red clay for paint. Stopped to camp about 3.30 when the rain commenced, erecting three very leaky lean-tos of sac-sac leaves. Aneroid reading 7300 feet. It rained all night, —not conducive to much sleep, considering the cold (it must be almost down to 20) and the condition of our roof. The kanakas kept five fires going to ease the discomfort. Totally naked, they certainly feel it less than me.

Tuesday, April 24.—Breakfast on the last of the bully beef and biscuits; most of the natives went hungry. By 9 a.m. we were on a reasonably continuous ridge and two hours later came up under the southernmost peak that shelters the crater. Our route circled this and led up to a sort of vantage point on the other side from which we could see the smoke of the volcano. A body of water lies to the southwest. I did not have time to determine its true size or character. Judging from the portion of the marsh we crossed, I should say it is mostly of this swampy nature and of no great extent or depth, although Riavite describes it as "big fella water." It was quite brackish to taste, containing numerous salts in solution, compounded by the thermal action of the earth and the seepage of rain. Iron and sulphur were decidedly noticeable. The natives would go no further; for it is their belief that anyone who gazes on the fire of Balbi will die, having offended the great Maker-of-Everything that they cannot understand, and therefore hold in fear and reverence. The two boys and myself set out on a rough bearing to complete the final leg of the climb, across an exceedingly rough patch of low scrub, matted cane, ferns, and long, stiff grass. This distance of a mile and a half gave us more travail than all the bamboo we had cut through down below. All the botanical life at this altitude indicates a different climate. Juniper and other species of hardy bushes abound, interspersed by great tufts of two-edged grass, reaching eight or ten feet in length, and queer, dwarfed trees—black, gnarled and leafless. Finally we emerged upon the hardened ash of the crater area, which showed sandy soil underneath when broken. Saline water flows in several gullies down the slope below the topmost ridge at the middle of which hangs a thin, yellowish cloud. Two other masses of sulphurous smoke near the big fire-pit indicate the presence of additional outlets for thermic effluence. The smaller produces heavy, stifling smoke in far too great a quantity to permit close examination. The other near at hand is in reality a wide fissure about 150 yards long and gives vent to steam mostly. When we reached the lip of the crater proper the atmosphere suddenly cleared, giving a remarkable view of both coasts and the great expanse of interlying terrain from our elevation (aneroid 8900) to the salt water. A westerly breeze afforded us an unmolested perspective of the immense caldron at least 500 yards wide, over 200 feet deep, its walls seared yellow and gray, blowing steam at every crack; and at the bottom a gigantic puddle of stirring, hot lava, evidently the cause of the incessant underground rumble we had noticed previously. One could easily descend to the level of the fused material and take observations. Being the only active volcano so ordered in the Solomons (possibly the New Hebrides included) it ought to be of particular interest to the scientist interested in seismic phenomena. For it is unusual to find a volcanic crater so dormant, yet of such manifest potency, and accessible for close study. In the instance of my visit the favourable wind and atmosphere were especially fortuitous. Lack of time forced us to descend as soon as we had built a little cairn and taken photographs. With considerable difficulty we found the markers left to indicate the spot where we had come out of the scrub, and in half an hour we had rejoined the tultul and his eager companions. By dint of strenuous pace we made the camp at 5800 feet just after dark where everyone fell asleep as soon as large amounts of food had been consumed.

Wednesday, April 25.—Marched in continuous rain, which rendered the recently-made trail very slippery. However, the safari managed to slide down to Hanua in the late afternoon, where sound shelter and bamboo beds were provided.

Thursday, April 26—Took leave of the old chief with mutual felicity at dawn, and with a much-reduced squad of carriers hiked to Pukuito. It is to be the first contact with the sea for most of the younger bushmen. Rain all afternoon.

Friday, April 27.—Two boys were despatched to walk 15 miles along the beach to inform the ship of our return, earlier than expected. Spent the day about our legitimate business.

Saturday, April 28.—All on board by 11 a.m. when we hove anchor and stood out for Buka Passage.

My lack of knowledge and instruments for tabulating any information of real significance to geography, or more specifically—meteorology, makes the importance of the climb negligible beyond the fact that it is the first. The use of the aneroid barometer gives a fairly accurate measurement of the altitude, which is marked on nautical charts 10,171 feet. Indeed, all similar Bougainville elevations, which were taken by sextant from the decks of survey ships, read less when tested by barometric ratings. The two peaks to the north and south of the crater are undoubtedly the conspicuous points of the mountain that are cited for navigators. They appear to be about the same height when sighted with a sextant, and I should estimate them not more than 1000 feet more than the crater. The accredited elevation, therefore, cannot be more than a hundred feet out. Whatever the exact figure may be, Balbi is the highest living volcano in the Western Pacific outside New Guinea itself, being rivalled in all the South Seas only by Mount Cook of New Zealand and Kilauea of Hawaii Island.

The Black Heart of New Guinea

By E. A. BRIGGS, M.Sc.

Acting Professor of Zoology, University of Sydney.

(Summary of Address delivered November 13, 1928.)

A journey up the coast of New Guinea to the Sepik River introduces one to various types of humanity and many cultures, not the least interesting being that due to the recent change from German administration to that of the Mandated Territory. There is no direct route. Samarai is visited, then Rabaul, at the extremity of New Britain. Matty Island, with its distinctive Malay culture, comes next, and the group of small islands—Tumleo, Seleo, Ali (all in the Berlin Roadstead)—and so past the Sepik River to Madang-Rabaul with its main wealth derived from coconut plantations, is situated on Blanche Bay. This fine expanse of deep water is a drowned volcanic crater, showing some activity as recently as 1875. Now casuarinas thirty feet high grow where there was then boiling mud. The natives are expert fishermen, constructing deep-water fish-traps of flexible split bamboo, held to the bottom by baskets of coral blocks and manipulated by vine cables 70 fathoms long.

In the Admiralty Group the canoes attract attention, with prow and stern decorated with a crocodile design and a handle provided on the outrigger to assist in portage. Here the islanders are the chief exponents of the art of "coiled" pottery-making. The very large canoes of the group of islands in Berlin Roadstead are even to-day hollowed from a single trunk by firestones and chipped with a stone adze; the sails are merely sheets of bark stitched together. The natives are intensely dark-skinned, with the black woolly hair, thick lips, broad nose, and heavy frontal ridges of the typical Melanesian. These people wear bark belts and display their wealth of shell money as necklets or stitched down on pieces of bark.

Madang, at the mouth of the Sepik River, was the west of the German administration. All along the coast is the raised coral reef, eight or ten feet above sea level; the coastal plain varies from a few yards to two or three miles in width. Cape Djereum juts seaward with windswept flanks; behind is Prince Alexander Range, and behind that again the high Victor Emmanuel Range. Rainfall is plentiful, and swift creeks flow thence to the sea, creeks that are difficult to negotiate, for they will rise very suddenly from a few inches in depth to become a raging torrent. Here the women are the toilers; they work in the home, they catch the fish, and labour in the garden plots in the foothills. The forehead "tumpline" is used to support the heavy loads of yams, pineapples, bananas, and taro. Cloth is made from beaten bark. A whole party of women will fish together, scratching about with their feet and holding nets with cane rods; at a signal all dive together, and rise with many small fish, which are placed in small lidded boxes attached to their waists.

The administration has succeeded in getting the villages built in orderly rows of houses; it has induced the occupants to keep clean sand floors, and to remove to more suitable abiding places the pigs, fowls, and family corpses. The latter were formerly suspended from the rafters, so that body juices, caught and rubbed into the living, might carry with them the valour and other good qualities of the departed. The huts are made of pieces of bark bound by "kunda," or native cane. The Germans initiated a regime of giving authority to a headman or "Luluai," wearing a broad red hatband. His subordinate, or "tultul," enforces orders and wears three red hatbands.

We have not space to describe the Singsing house for public ceremonies, and the garumets or signalling drums, and the palmfrond water buckets. Nor can we do more than mention one or two customs—that of betel chewing; the mourning custom, where a widower smears his whole body with a light yellow clay (even a pet pig may be thus mourned); the young girls have their noses perforated and the slits distended with split bamboo; a decorative nose plug is a girl's portion when she marries, and the slits are prepared early.

The expedition proceeded inland through the dense jungle to the mountain ranges. These rise sheer to 7,000 feet, and the vegetation persists to the top. Progress can only be made through actual hewn tunnels in the thick growth. Here again the huts of the villages are built in line, but now, owing to the nature of the topography, the strategic position is along the most lofty ridges. Weapons in the form of daggers are made from the long hollow thighbones of the cassowary, and valuable media of exchange are dogtooth necklaces and shell money. On the mountain tops the physical type of the natives improves, and they are notably intelligent.

The descent on the other side is through regions of jungle and tall grass. Here the huts are larger and of a communal type, and the cast of countenance of the natives is almost Semitic, though still classed as Melanesian. Pygmy types are also found in the Sepik district, though they have mostly abandoned their jungle nomadic habits for a crude agriculture.

Many small streams drain the sago swamps, which extend twenty miles each side of the Sepik River. The mosquitoes here are dreadful. An interesting feature is the long, thin, straight nose that appears on the Singsing masks, combined with thin lips; these masks are worn with the face at the back, so the performer has two faces. All around the Singsing house are massive statues and carvings recalling the mysterious monuments of Easter Island, with the crown-like structure on the head and the classic features. And here, too, their origin is shrouded in mystery. The Sepik River natives are able to saw thin plates of stone by means of strips of green bamboo, held in a slow fire and so dried and armoured with water and grit; these fibres must be frequently renewed, but the stone is cut and breastplates manufactured.

PELAGIC FISH EGGS.

Most of our principal edible fishes have pelagic or floating eggs. Geographical distribution (including local distribution in inshore waters) is effected mainly by ocean and tidal currents; but winds play a very great part. Notable instances of these fishes are the Snapper, Flatheads, Sand Whiting, Leatherjackets, Blackfish, Black Bream, Sea Mullet, Flat-tail Mullet. The Sea Mullet perform a very noticeable migration from the upper waters of the estuaries to the ocean during April and May. They travel for short distances to the northward on the south-flowing stream, meanwhile spawning.—(David G. Stead.)

Localisation of Industry in Coastal Regions of New South Wales

By CATHERINE DOYLE.

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I.—PRELIMINARY SURVEY.

1.—Introduction.—The material welfare of any community is determined by a great number of factors, and one would hesitate to dogmatise as to the relative importance of any one of them. It remains, however, as a fact that environment is probably the least studied of these, and it is certainly one of the most worth study, because of its human interest. It is in this respect that economic geography assumes importance.

Perhaps the most obvious field for the activities of the economic geographer is that of localisation of industry. In the first place, he must work purely as a geographer and make his study on those primary natural aspects which must be absorbed before he can begin to apply them to the economic problem. He will study the topography of his district first, discovering its formation, its waterways, its barriers, finding its harbours, water supplies, the relation of its highland to its lowland, and making a general descriptive inquiry into its build.

Closely bound up with the physiography is the geological review of the area. The geographer cannot go far in his investigations of physiography without falling back on his knowledge of geology for explanation of many of the phenomena he describes. The age of his district is important for correlations, and upon the material of his strata depends the whole question of soils—a very big factor in the economic development of any area.

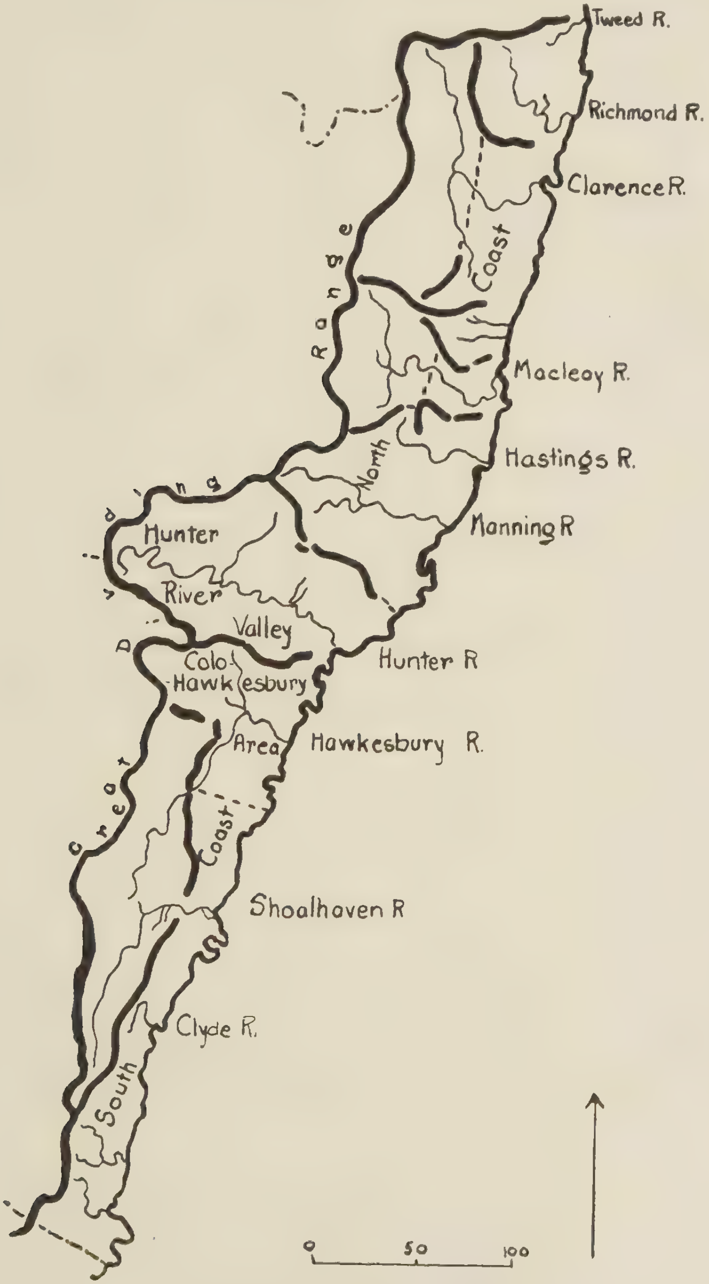
Almost more important than either topography or geology is the climatic environment. Clearly, any tract of country, suitable though it may be in soils, cannot be exploited if the climatic conditions are impossible. The study of climate is detailed, since account must be taken of such factors as temperature, winds, currents, amount of rainfall, and, more important, season of rainfall, evaporation, and humidity. All these affect development and are of vital interest to the individual as well as to the group.

Lastly, the investigator takes account of the primary products of his district. He continues a purely descriptive investigation into the past and present productivity of the area, and is careful to note distribution.

The second set of investigations to be made is in the form of inference from this descriptive research. Existing and possible future communications should be studied, these obviously depending on the already-described topography. Roads and railways are built where they are most necessary and where expense is least. On the knowledge of geology and meteorology gained, the suitability of soils and climate for further development is determined, and from the study of primary products the question of secondary products can be investigated.

This naturally leads on to a third group of study, this time from an almost purely economic standpoint, and having for its keynote the study of correlations. In this way a fairly accurate prophecy may often be made concerning the future of primary and secondary industries, communications, and the spread of population. The possibility of opening up areas hitherto avoided for lack of means to develop them is a necessary study. Districts with soils excellent for certain valuable crops are too far from markets to make clearing profitable, or in districts close to markets the soil is too poor or too badly drained for ready cultivation. These present problems which must be solved for the surely-advancing tide of occupation.

2.—**Distribution of Population.**—The districts it is proposed to investigate are the two strips of coastal plain spoken of usually as the North and South Coasts of the State. The North coastal strip here discussed stretches from Tweed Heads in the north to Cape Hawke in the south, bounded on the west by the New England and Mount Royal plateaux. The South Coast extends from Port Hacking, in the north, to Cape Howe, in the south, and is bounded to the west by the Illawarra, Currockbilly, and South Coast Ranges.



MAP OF COASTAL AREAS.
- - - - - Portions under discussion.

We find a considerable difference between the settlement of the North Coast and that of the South, in that there is more tendency for the population to be distributed over larger areas in the South and clustered in smaller districts in the North. Thus, in the South, we find two fair-sized areas, one to the north of Bulli and one along the lower Shoalhaven, with fifty to a hundred persons to the square mile, and from Bulli to Wollongong, an area seventeen miles long and five wide, with 100 to 200 persons to each square mile. The densest population, however, is found around Wollongong, with from 500 to as many as 3,000 persons to the square mile, and Bega, with 500 to 600 per square mile.

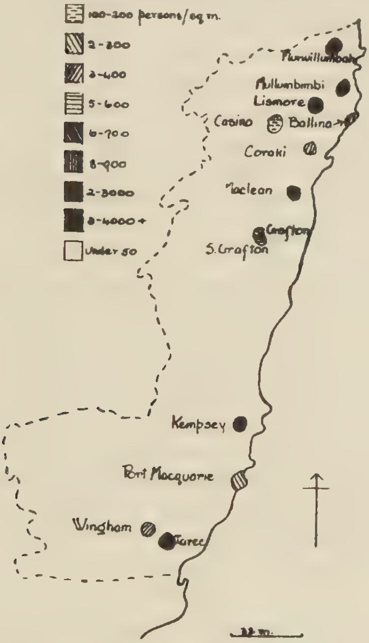
In the North Coast the population is centred in the towns. Of these, Casino and Grafton have the least density, with from 100 to 200 persons per square mile; and Taree and Lismore have the greatest, with 3,000 to more than 4,000 persons to each square mile. Murwillumbah has from 2,000 to 3,000, and Maclean and Mullumbimby each 800 to 900 per square mile.

At the beginning of the century the distribution was substantially the same in the South Coast, but was somewhat different in the North. Lismore was still the most densely-settled municipality, but Taree was one of the least densely-settled, and Murwillumbah and Mullumbimby each had less than fifty persons to the square mile. This divergence in the difference of densities in the North and South Coasts is partly due to the fact that the South Coast has been settled for a much longer period than the North. Certain areas, such as Kangaroo Valley and the environs of Wollongong, in the South, are even now approaching saturation point; but the North Coast is still developing rapidly.

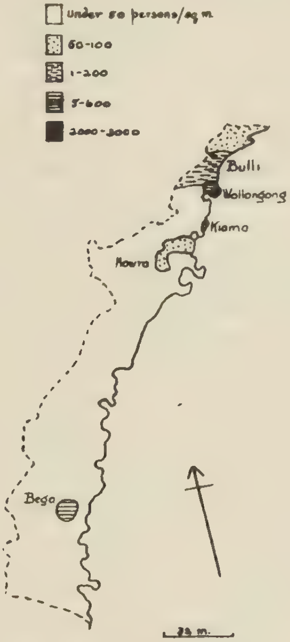
We have now to seek the reasons for the existing distribution of population. There are several things to consider in this respect. The first is the geology of the areas. This indicates the distribution of mineral wealth and of good and of poor soils. Secondly, the topography must be considered. A fertile strip of land is useless, under present conditions, if it is separated from markets by heavily-dissected country; or good soil, if it occurs on steep slopes, is left unexploited as long as there is more level country available, until overcrowding of the plains presses it into service, both because it is difficult to work and because the soil is easily washed down. Thirdly, climatic conditions must be studied. Too much or too little rain, too high or too low a temperature average, may make or mar the economic development of such districts.

In the South Coast the densest population is along the coastal plain from Bulli to Wollongong. This corresponds to the area of Permo-Carboniferous upper beds with their rich coal seams and fertile soil. Population will always be dense on a coalfield such as this, even if the surrounding country cannot be used for agriculture; but in this case the soils of the coalfield are well worth cultivating. This district is an almost classic example of conurbation, for the coal industry has caused a mushroom growth of small townships, which are spreading rapidly, so that there is an almost continuous line of settlement along the railway from Coaldale to Wollongong. The most intense settlement is at Wollongong itself, because Port Kembla, with its artificial harbour, is the sole outlet for all the industry of this busy coastal tract.

The Bega district lies on granite country, excellent for grazing, with a fairly wide strip of alluvium along the river. The fertile valleys directly behind Kiama are fairly thickly populated, because of the excellent basaltic soil, and the rich delta of the Shoalhaven supports a relatively dense population.



Density of Population, Present Day, North Coast.



Density of Population, Present Day, South Coast.

Naturally a mining area will have a denser population than an agricultural or dairying area, because, from the nature of the industry, there must be a certain number of acres to each person in farming land.

The amount of coal, however, is limited in any place, and the amount of land available for farming is not limited to anything like the same extent. Scientific investigation is continually revealing methods both for using land hitherto considered useless, and for increasing the productivity of land already under cultivation. Long after coal is exhausted in the Southern coalfield, there will be scope for increase in production of foodstuffs in the same area. Coal, too, can be replaced in its uses by several other sources of energy if necessary, but we cannot do without food. Thus, although the industrial world seems to be superseding the pastoral, this is not necessarily so, because the pastoral industry has held its own, even though the provinces of its development have moved, through numerous changes in the mode of life of succeeding generations of workers. The immediate environs of Sydney are not used as farming land now, but Sydney is much better supplied from farther afield than she ever was in the days of fewer workers and more unused land. This means that there will be an increase of production, with an increase of the number of workers and the amount of exploited land.

The rest of the South Coast supports at present less than fifty persons to the square mile; and a glance at the geology shows that, except for occasional outcrops of igneous material, the coastal strip is made up of sedimentary rocks, mostly unsuitable for intense settlement. Jervis Bay is one of the finest ports in Australia, and yet its immediate hinterland is almost empty of population, and it is only where the silt areas of the Shoalhaven delta begin to the north and north-west that the population is appreciable. The barren and acid, badly-drained Permo-Carboniferous sandstones of the country behind the bay support little valuable vegetation and encourage little cultivation. For the same reason, the Permo-Carboniferous area between Kiama and Gerringong is sparsely settled. South of the Shoalhaven it is almost possible from the geological map to indicate which areas will be thickly populated, because the centres of settlement almost exactly coincide with the outcrops of igneous rocks along the coast.

The North Coast presents a different type of problem. Here there is no extensive coal-bearing area, for the coal basin has its northern limits in the Hunter Valley, so that the population clusters round smaller centres. Upon investigation we find that these lie along the river valleys, and that distribution of population here depends not so much on the geology as on the topography. Jensen shows that a great deal more of the North Coast than of the South consists of rocks yielding fair soils, and that, while there are areas of bad soil, yet there are many large areas of excellent soils. On the other hand, the country between the rivers is usually elevated and fairly well dissected, so that the population naturally settled in the river valleys first. Later, no doubt, the range-country will be settled, but not until the valleys begin to become crowded. To a great extent the valleys correspond to the districts with the best soil, since most of the northern rivers flow through extensive flats of silt, which they carry in their steep descent from the plateau to the west. Taree is on the Manning, Port Macquarie near the mouth of the Hastings, Kempsey in the Macleay Valley, Grafton in the

Clarence, Lismore in the Richmond basin (on basalt, however), and Mullumbimby (on the Brunswick) and Murwillumbah in the Tweed Valley. Bellingen, in the fertile Bellinger-Nambucca valley, and Dorrigo, on the Dorrigo Plateau of basalt, are growing rapidly in importance, and will no doubt soon become larger centres of settlement than they are at present.

The occupations of the population of the coastal areas fall into two groups: (a) the natural or primary industries, and (b) the artificial or secondary industries. By (a) is meant those occupations which depend simply on the extraction of wealth in its natural form, either as minerals or foodstuffs. The second group (b) includes those industries which develop primarily from the existence of the natural industries and take the form of occupations designed to supply the needs of those engaged in the primary industries, as well as to be profitable to those engaged in them. They comprise manufactures which turn the raw materials of the first group into usable form.

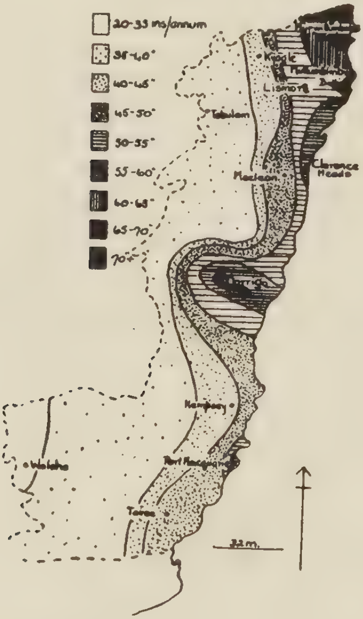
The large industry of dairying lies somewhere between the two. It may be argued that this should be included in "(a)," since soil, topography, rainfall, etc., have as much to do with its development. This is true of dairying under most conditions, but no area, however suitable, can develop into a dairying district unless there are markets close at hand and a demand to equal the supply, because land suitable for dairying is also suitable for grazing and exclusive agriculture; and unless land is made expensive by the growth of settlement close to it, it does not pay the farmer to turn his acres into a dairy farm.

The manufactures are localised also from the nature of the primary industries. For instance, iron works are erected at Port Kembla because there is a supply of coal at hand and a fairly good harbour for export; and fertilising works grow up close at hand to use the sulphur which the iron works discard in their processes. Butter factories grow up to supply the works with butter, and, because there is suitable land to hand, more milk is produced than is needed immediately, and so surplus butter is sent to Sydney for export. All the industries are therefore localised and interdependent.

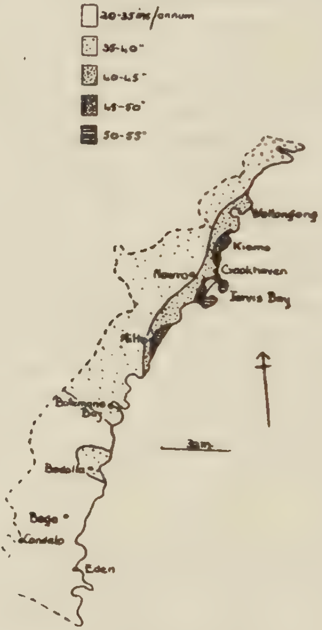
From this outline it becomes obvious that before we describe the industries of the North and South Coasts, we must briefly understand (a) the climate, (b) the physiography, and (c) the geology.

3.—Climatic Conditions.—The anti-cyclones are the main factor in determining climate in New South Wales, and since these pass from west to east, revolving in an anti-clockwise direction, with their centres in 25° latitude in winter, moving to 30° in summer, the prevailing winds of the North Coast are easterly or north-easterly, and of the South Coast are north-westerly. The South Coast plain is, however, so narrow that the daily circulation of the atmosphere depending on the radiation of heat from the land close to the sea causes a more or less local wind system, wherein the easterly sea breeze plays a large part.

The rainfall is affected by the Pacific Ocean to the east and the elevated plateau to the west, and both coastal areas are well watered by rain-bringing winds which come in from the sea. The North Coast is considerably wetter than the South. The average annual rainfall ranges here from over 70 inches at Ballina to 40 inches at Kempsey and Kyogle and 35 inches at Tabulam. The north-east portion, in the Tweed valley, and the elevated Dorrigo plateau in the centre, receive from 65 inches to 70 inches per annum, and the lower Richmond valley receives from 60 to 65 inches.



Average Annual Rainfall, North Coast.

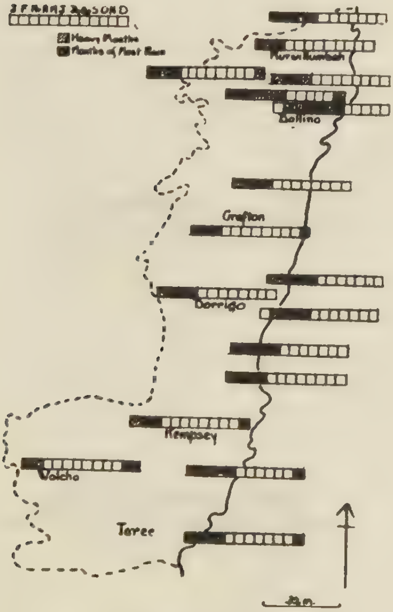


Average Annual Rainfall, South Coast.

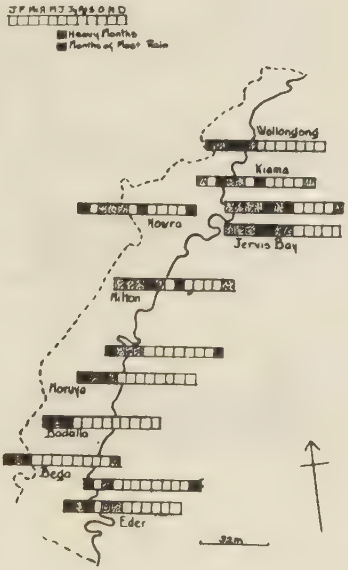
In the South Coast no district receives an average of more than 55 inches in a year. Jervis Bay is the wettest area, while the Kiama and Milton areas receive from 40 to 50 inches. South of Bateman's Bay not more than 35 inches falls in a year, except in the Bodalla district, which receives up to 40 inches.

The North Coast gets most of its rain in the late summer and early autumn. From January to May are on the whole the wettest months, with February and March receiving the maximum. Theoretically, the South Coast belongs to the region of uniform rains, and this is shown fairly well by readings from individual stations; but from Moruya south to Eden the summer maximum predominates. From Wollongong to Milton the months of heaviest rainfall vary from March and April to May and July; but southwards the heaviest months are December or January to March.

In both North and South Coasts, however, the rain belts move eastward from summer to spring. In January, in the North, Murwillumbah and Byron Bay are in the 800 to 900 point zone, and the Dorrigo district in the 600 to 700 point zone. In the dryer South, in January, Wollongong, Kiama, Jervis Bay, Milton, and Pambula are in the 400 to 500 point zone. In April Murwillumbah and Dorrigo receive from 600 to 700 points, and in the South the 200 point line bulges eastward. In the same month, however, Jervis Bay receives up to 600 points. In July the belts have moved still further east, so that Murwillumbah is only receiving 300 to 400 points, and the coast south of Milton receives 300 points only in isolated districts. In October only Port Macquarie, the Dorrigo-Coff's Harbour district, and Murwillumbah in the North, and a zone from Jervis Bay to Milton in the South, receive more than 300 points. By January the cycle begins again.



Season of Rainfall
(North Coast.)

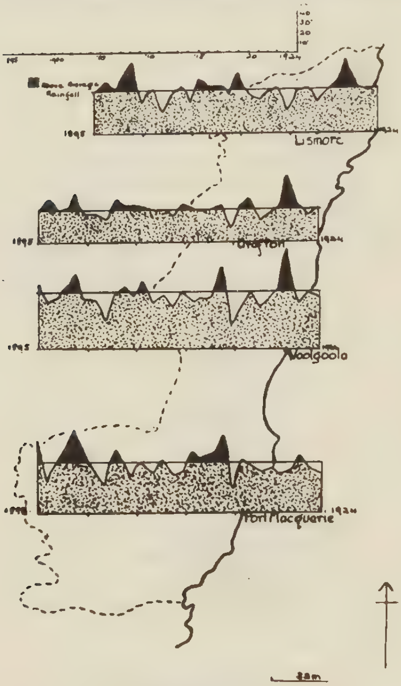


Season of Rainfall
(South Coast.)

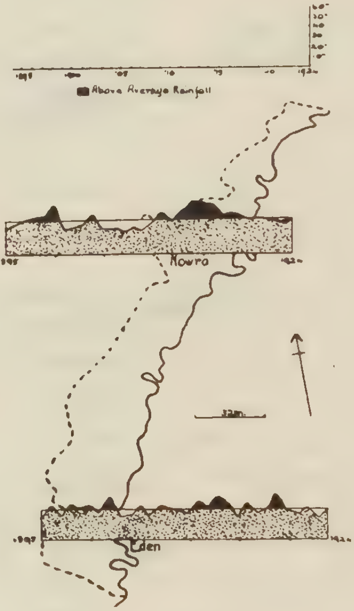
Variability of rainfall (taken over a period of thirty years) is more marked in the North than in the South Coast, the tendency being more for an extremely wet period here to be followed by several years slightly below average, while in the South variations are more even.

PHYSIOGRAPHY.

1.—Introduction.—Four impressions are gained by a glance at the coastal areas of New South Wales. First the uniformity of direction—the coast runs almost without deviation from N.N.E. to S.S.W. Secondly, the fact that this characteristic is shared by the axis of the uplifted peneplain of the Divide which runs almost quite parallel to the line of the coast all the way. Thirdly, the narrowness of the coastal areas. Except in the Hunter Valley, the average width of the coast is 60 to 70 miles, and this narrows in the south to as little as 20 miles. The fourth characteristic is the profusion of dissections in the actual coast line. These take different forms; in the extreme south they consist of reefs and rocky, sea-carved islands; in the centre they are large inlets like Port Jackson and Broken Bay, with sheer shores and deep water; and in the north they are chiefly lagoons and shallow barred coastal lakes.



Variability of Rainfall,
1895-1924, North Coast.



Variability of Rainfall,
1895-1924, South Coast.

2.—South Coast.—The most obvious characteristic of the coast from Cape Howe to Port Hacking is its youth. The two factors most vitally concerned with the production of this stretch of the coast as it is, are the geology and recent tectonic movements—slight coastal oscillations, sometimes fairly general, sometimes only local.

From Sydney to Stanwell Park there are sheer cliffs to the sea; but from here south, a well-marked coastal plain develops, interrupted at intervals by outflung spurs from the scarp to the west. There are no rivers crossing this coastal plain south from Port Hacking until the Shoalhaven, but there are a few small streams, some of which, particularly the Macquarie Rivulet, are eating back into the scarp. South of the Shoalhaven, which is the only large river of the South Coast, are several smaller rivers, the largest of which is the Clyde, flowing into Bateman's Bay.

There is a good deal of evidence of recent uniform uplifts, and examples such as Lake Illawarra and the Tom Thumb Lagoon, the barrier beach at Gerringong, the truncated spurs near Bulli, and benching in the Shoalhaven above Nowra are numerous.

To the west the coastal plain is bordered by two distinct plateaux. The more northerly may, to follow Harper, be referred to as the Robertson Tableland, and that to the south as the Sassafras Tableland. The Robertson plateau forms what is known as the Illawarra Range, and throws out several well-defined spurs across the coastal plain. The Sassafras Tableland forms the Turpentine Range, which, to the west and south, merges into the Currockbilly Range. The latter joins the larger Gourock Range, and south of Mt. Nimitybelle is known as the South Coast Range to the Victorian border.

There are numerous spurs from these ranges, and enclosing the Bermagui district is an isolated pleateau rising to Mt. Dromedary and Mt. Mumbulla. These southernmost plateaux are affected to a considerable extent by the block faulting which is characteristic of south-east Australia, so that what are known as ranges are the exposed sides of fault blocks, and this has an economic importance which becomes obvious in the consideration of transport.

The South Coast falls into five topographic districts, and can best be described by surveying each briefly.

(a) The area from Cape Howe to the Bega River includes the areas of drainage of three streams—the Towamba, the Pambula, and the Bega. None of these is large, mainly because here the coast is extremely narrow, with the South Coast Range running close to the shore line. The coast itself is rugged, with frequent rocky headlands made by outflung spurs from the plateaux. Twofold Bay is the largest inlet, and forms a very fine harbour. Cape Howe, Green Cape, and Tathra Head, at the entrance of the Bega River, are the most prominent features of the coastline.

The soils of this area are varied, and on the whole not useful for cultivation. They are formed mainly from the Devonian strata, with occasional patches of granite. Jensen describes a fairly large area of granite round the western basin drained by the Brogo and Bemboka as being chiefly good soil.

(b) From Bega to Moruya is the second district, including the Tuross and Moruya Rivers, and bounded by the high fault-blocks of the Gourock Range to the west. It includes, also, the small Bermagui district surrounded by the isolated plateau from Mt. Mumbulla to Mt. Dromedary. There is a very small stream here, the Bermagui River, but, except for a small patch round Lake Wallaga of good soil, this corner of the country is very poor.

(c) The third area is almost all country of bad soil. It consists of the Clyde drainage basin, and, with the exception of a patch of diorite, in the north-east, is composed of the Nelligen phyllites.

The coastal plain here is a gently sloping tract of country from five to six miles wide, rising from the shore-line to the plateau in the west. There are a number of small lagoons along the coast here, and at Ulladulla is "a raised sea-cut platform" (Miss I. A. Brown), all evidences of subsidence followed by uplift.

(d) The district from Ulladulla to Gerringong may be divided for greater ease of description into three arbitrary areas —the lowlands behind the bay, the highlands, and the river delta.

Contours of the area show a relatively wide coastal plain immediately behind Jervis Bay, merging in the north to the wide and extremely low-lying delta of the Shoalhaven, and in the west to a steep monoclinal warp—the Sassafras Plateau—which extends south for some distance and gradually peters out to the north until the town of Nowra is built on the foothills.

The coastal plain is unremarkable unless it be for its barrenness. It is very gently undulating, at no place rising to more than a hundred feet above sea level. To the south it slopes away to St. George's Basin, and to the north verges into the silt areas of the Shoalhaven delta. It is crossed by several small creeks, the largest of which is Currumbene Creek, rising near Nowra Hill, on the edge of the plateau, and entering Jervis Bay at Huskisson, where its mouth has been drowned, forming a small estuary.

The plain is composed of sterile Permo-Carboniferous strata yielding a reddish-grey soil. The vegetation is xerophytic and somewhat universally stunted. The main types are eucalypts, acacias, banksias, grevilleas, leptospermum, macrozamia, and quantities of the common pteris or bracken. To the west the coastal plain merges gradually into the Sassafras Tableland, which rises to 2,500ft. at Sassafras.

The area of the Shoalhaven delta, if we include the Coolangatta Swamps, is approxiamtely twenty-five square miles. There can be little doubt that there was here once a lagoon of the same type as Lake Illawarra at the present time, moved slightly above sea level by an uplift of the coast line, and rapidly filled in by the Shoalhaven. When the fairly rapid infilling of Lake Illawarra by the small Macquarie Rivulet is observed, it is easy to realise that a large river like the Shoalhaven could fill such a lagoon in a very short time. Coolangatta Hill is, of course, an inlier of basalt in the silts.

The river encloses several islands in its meandering through the delta area, the largest of which are Pig Island and Sandpit Island, low, bushed expanses of mud and silt.

The Coolangatta Swamps comprise the lowlying area round Coolangatta Hill, and are drained by a number of small meandering streams, the largest of which, Broughton Creek, flows into the Shoalhaven behind Coolangatta Hill. A great deal of the swamp area has been reclaimed on the Berry Estate, and forms extremely rich dairying land.

The soils of this section are almost uniformly poor, derived as they are from the Permo-Carboniferous sandstones; but there are three patches of good soil—one around Milton, on diorite; one on the Sassafras basalt; and thirdly, the silts of the Shoalhaven delta.

(e) The fifth section is from Gerringong to Port Hacking, and may be subdivided into three sections: (i.) the area of basalt spurs from Gerringong to Wollongong; (ii.) the area of coastal plain development, from Wollongong to Stanwell Park; and (iii.) the area of sandstone cliffs on the southern ramp from Stanwell Park to Port Hacking.

3.—North Coast.—The strip of country known as the North Coast, and described by Sussmilch as "the much-dissected eastern portion of the main tableland," is on the whole a great deal wider than the South Coast strip. It rises in the west to the main New England Range, but is interrupted throughout the whole of its length by coast ranges, which come in many cases down to the shore line. Despite the fact that they are at right angles from the main divide (here the New England Plateau), the main trend of the coastal ranges seems to be roughly north and south.

The area falls into five sections, corresponding to the basins of the Manning, Macleay, Clarence, Richmond, and Tweed rivers. The Manning drains an area of about 3,000 square miles, and is fresh as far as Wingham, i.e., for about thirty miles upstream. The Hastings does not drain nearly so extensive an area as the Manning, although it has a well-developed tributory system. The soils of this area are on the whole fair, with three distinct portions of good soil and one of bad. A large area to the north-west, drained by the headwaters of the Hastings and the northern tributaries of the Manning system, is a good basaltic soil, another patch of which is found along the lower Hastings. Two other patches of good soil occur in the Manning area—one of alluvium along the lower Manning itself, and a large outcrop of andesite drained by the Barrington. The rest is fair, except for a patch of bad soil behind Camden Haven and Watson Taylor's Lake on carboniferous sediments.

The lower basin of the Macleay comprises the next section. Here it flows through a great expanse of alluvium, spoil of its rapid erosion in the western divide, and enters the sea at Trial Bay. The soils here are mostly this alluvium along the river, and, as for the rest, soils marked fair by Jensen, over limestone and slates and schists to the west and north-west.

The northern section is composed of the areas drained by the Nambucca and Bellinger. The Nambucca rises in the North Coast Range and flows through elevated country for a short distance, when it enters a large tract of alluvium and enters the sea by a fairly large estuary. It is navigable for about twenty-five miles. The Bellinger is very similar. The soil here is excellent, and between the two streams is fair, composed of dtritus from metamorphic Silurian schists and slates.

The next section includes the lower reaches of the Clarence River. It is the largest of the North Coast streams, and is decidedly T-shaped, the north and south branches forming the head of the letter, draining a very extensive area. It is, however, again only with the lower reaches of the river, after it breaches the North Coast Range near Coal Ridge, that we have to deal.

The river, after leaving the gap, becomes rapidly more and more mature, and meanders through a very extensive silt plain, finally wandering through a large delta, forming several islands (as in the Shoalhaven delta), and several wide expanses of water, the largest of which is known as the Broadwater, until it reaches the sea in Shoal Bay. The main southern tributary of the Clarence, the Nymboida, also breaches the coast range a good deal further south, and then likewise wanders through silt deposits.

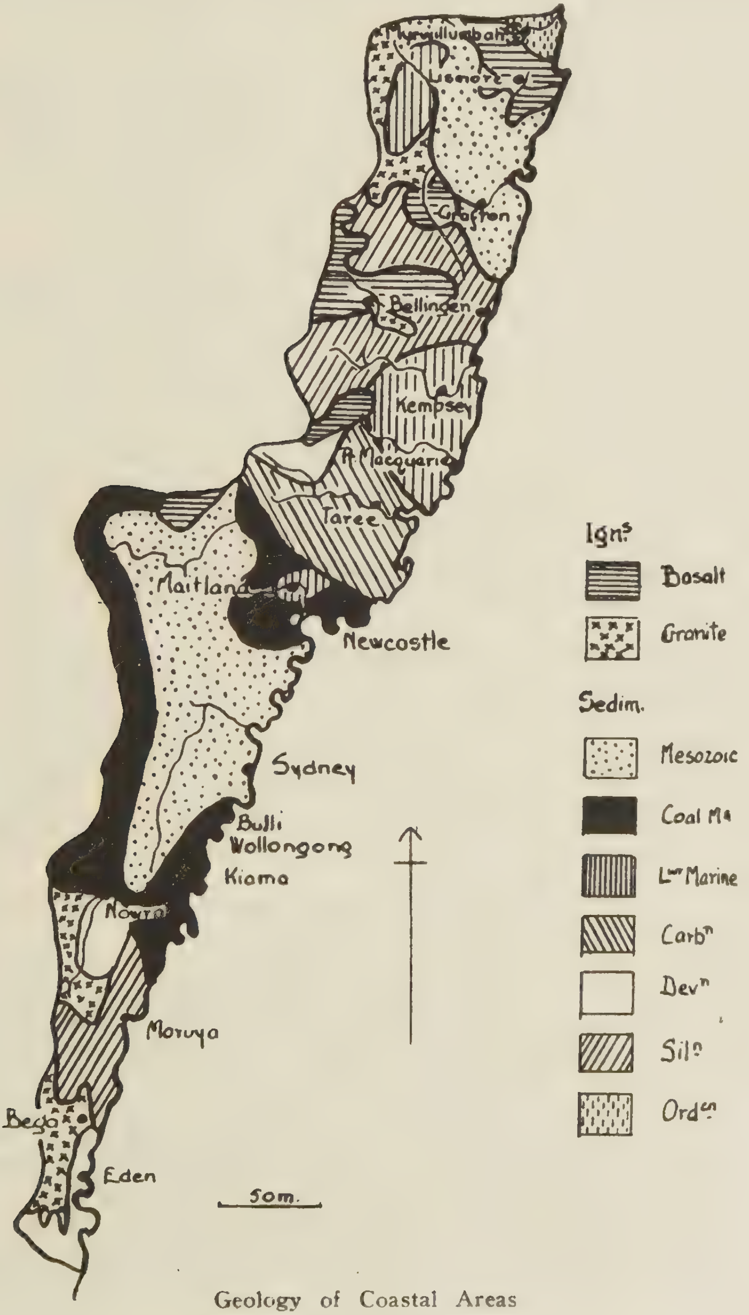
The soils, beyond the extensive areas of alluvium, are not good, consisting for the main part of the sterile Clarence Triassic beds. Just north of Coff's Harbour, however, is an area of fair soil on the metamorphosed Silurian rocks.

The Richmond basin comprises the fourth section. Its upper reaches are youthful and swiftly flowing, but it later becomes mature, and reaches the sea after flowing through alluvial tracts. There are considerable areas of good soil in this section, mostly river alluvium, along the stream itself, and basalt flows to the north and west. The rest is fair, mainly of Mesozoic sandstones.

The Tweed flows for its whole length over rich basalt country. It reaches the sea through an estuary at Tweed Heads. The Brunswick is a small stream running into Byron Bay some miles south of the Tweed. The soils of this section are almost uniformly good, with a strip of slightly less useful soil along the coastline.

III.—GEOLOGY.

1.—South Coast.—In the South Coast there is a big range of geological formations in the area between Cape Howe and Port Hacking, and the strata range from Ordovician to Recent, and are associated with a number of igneous groups. From Cape Howe to Ulladulla is an area of Devonian and (?) Silurian rocks, but from here north to Sydney the two main eras concerned are the Permo-Carboniferous and the Triassic, the latter lying immediately above the former. The strata of both series



Geology of Coastal Areas

all dip slightly to the north, so that the lower beds are gradually exposed. These are all softer than the upper beds, and so cause the development of the coastal plain beyond Bulli, the scarp of the Robertson Plateau receding gradually but definitely to the west and the harder top layers forming a unique and very characteristic capping.

2.—North Coast.—The rocks of the North Coast range from Ordovician to Recent. The whole area is one of extensive basalt outpourings, which took place mostly in Tertiary times. Granite intrusions are fairly numerous, especially to the west.

The Ordovician beds outcrop in the Tweed River district, where they consist of contorted slates containing veins of hydrous phosphate of alumina (turquoise).

The Silurian strata occur along the coast, chiefly in the Coff's Harbour and Brunswick River districts. They consist of contorted schists and slates, and extend westward as far as Armidale, intruded heavily by granite and basalt.

There is a fairly large outcrop of Devonian rocks in the region of the headwaters of the Manning River, also metamorphic in nature and yielding a fairly good soil.

The Carboniferous period is represented by an extensive development of "tuffaceous sandstones, claystones, limestones, conglomerates, cherty shales, with contemporaneous lavas and tuffs" (Sussmilch, "Geology of N.S.W., page 85). The beds are interstratified fresh with marine, the fresh beds including some thin coal seams. The contemporaneous lavas are mostly rhyolitic.

The Permo-Carboniferous period is represented in the North Coast by the Lower Marine series, a large outcrop of which occurs from Camden Haven to Trial Bay, and westward for a considerable distance. They consist mainly of shales, sandstones, and conglomerates, with associated andesites and tuffs. They form very poor soils, and are greatly folded. They are intruded at Port Macquarie by serpentine, and are overlain from here to Trial Bay by deposits of alluvium, and have in several places been intruded by granite.

There is a large area of Triassic fresh-water beds in the Clarence basin. They are known as the Clarence Beds, and resemble somewhat the Hawkesbury series. They consist of basal conglomerates overlain by sandstone and shales, and are 3,700 feet deep at Grafton, where a bore was sunk. They occur in a basin-like depression (M. Morrison, "Some Notes on the Geology of the North Coast District," Pan-Pac. Guide to Moree and the N. Rivers), the main axis of which is parallel to the coast line. The lower beds contain several well-defined coal seams, which, however, are not very valuable. In this respect they differ from the Triassic beds of the Sydney district.

There are, of course, very extensive areas of Recent silt and alluvium along the rivers and their estuaries. These loads have been brought down by the streams in their rapid descent from the plateau to the west.

There are heavy intrusions of granites and porphyries in the north-eastern portion of New South Wales, but not a great deal of these are included in the strip under discussion. They occur, however, in the Murwillumbah district in the Tweed valley, and again near the breach in the divide made by the Clarence.

The basalt flows which occur profusely all along the North Coastal strip, especially in the Tweed-Richmond and Dorrigo districts, form excellent soils, the Richmond River basin being one of the richest areas in the State.

IV.—DAIRYING.

1.—Introduction.—Although dairying is the most important occupation of both North and South Coasts of New South Wales, yet the history of its development, the conditions under which it is carried out, and the reasons for its rapid progress in each district are different.

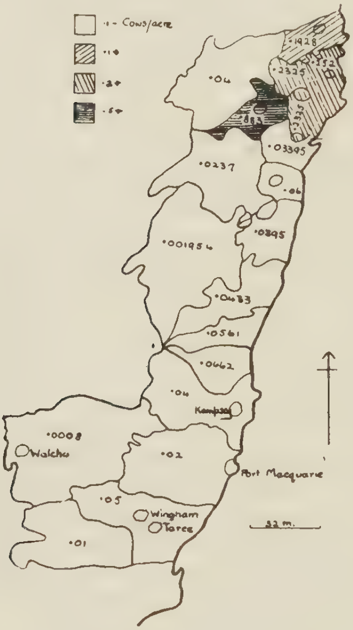
In the first place, the rainfall of the North Coast is considerably heavier than that of the South. The mean annual rainfall of the North is approximately fifty inches, while that of the South is 33.09 inches (averages for the last quarter-century) —a difference of nearly twenty inches. Most of this rain falls in the late summer in the North, but in the South it is much more uniform. The North Coast is a good deal warmer than the South, and this has a direct influence on the industry, especially in the manufacture of cheese. Again, the topography of North and South Coasts is different, the soils by no means equal in nature and value, and the markets are quite dissimilar.

As far as dairy products are concerned, the South Coast may be divided transversely into two parts about the Shoalhaven, the more northerly of which concentrates on the production and marketing of milk itself, and the more southerly on the manufacture of cheese. On the other hand, the North Coast concentrates almost wholly on the manufacture of butter. Both areas, but more especially the North, make pig-raising and bacon-curing a parallel though smaller industry.

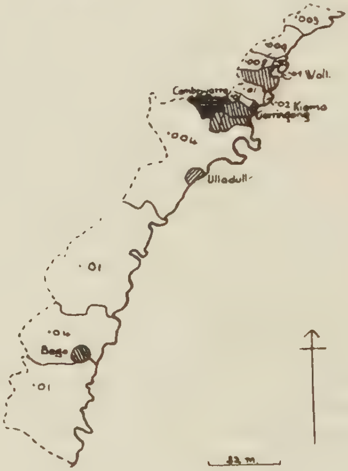
This difference in products in North and South is easily explained, the explanation depending on the mode of development of the industry and on the climate. The South Coast, especially the Illawarra district, was the first area in the State to take up dairying on a large scale. This began towards the end of the eighteenth century, and the main object of the industry was to supply the growing metropolis with butter, which, in those days of no refrigeration, was very difficult to transport satisfactorily in summer. The discovery and consequent working of coal gave an added impetus to the young industry, which developed rapidly. As it spread southwards the distance to Sydney became too great for transport of milk and butter, and so the milk began to be made into cheese, for which the temperature in the Bega district is exactly suitable.

Towards the end of the nineteenth century, however, the introduction of refrigeration and improved machinery (notably the separator) made it possible for Australia to seek outside markets for her dairy produce, and 'the North Coast, too far away to supply Sydney with milk, and so almost neglected up till this time as a dairying district, began to be rapidly developed. Milk was not needed except by the local settlements, and the temperature was too high for much cheese-making, so the North Coast has concentrated on the making and marketing of butter.

It is obvious that increase in the output of butter depends on increase in the milk yield, which in turn depends directly on increase in the population (assuming that factors such as rainfall and temperature are equal). The following graphs show these relationships, and particularly the rapid parallel increase of both population and milk yield in the twenty years from 1901 to 1921 in the North Coast.



Number of Cows to the Acre, North Coast.



Number of Cows to the Acre, South Coast.

2.—**History of Dairying in Illawarra District.**—A brief outline of the history of dairying in the Illawarra district is interesting in bringing out the main lines along which the industry develops almost everywhere. The economic development of the Illawarra district has passed through the usual stages of increasingly intensive exploitation of a typical dairying area, accelerated rather than interrupted by the discovery and working of coal in one portion of it.

As is almost invariably the case in a newly-opened area, the first occupation was timber-getting, and the real pioneers were the cedar-cutters. Grazing followed, gradually growing more and more important, until it almost entirely superseded the cedar-cutting. Grazing is usually the second stage in economic development, because land is cheap and markets are too far off for profitable carrying on of a closer industry. Gradually, as settlement grew and the discovery of coal sent the population up rapidly and the price of land rose with it, the farmer turned his acres into a dairy farm, and the South Coast became the nucleus of the dairying industry in New South Wales. The details of this development are interesting.

Up to 1799 nothing was known of the coastal country south of Botany Bay. In that year, consequent upon the severe drought of 1798, which was followed by disastrous floods on the Hawkesbury, Governor Hunter had a survey made of the coast, chiefly with the object of tracing and reclaiming the progeny of cattle which had wandered from the settlement on Port Jackson in 1788 and could ill be spared. In the course of this survey the Shoalhaven River was discovered and named. The second great drought in 1804 caused Governor King to organise another survey party down the coast.

For the first twenty years of the nineteenth century, however, very little was known of the area. Men began to break into the deep gullies for cedar. The trees were felled on the slopes of the coastal ranges, drawn by bullocks to the coast, and shipped to Sydney. The cedars were not found on the coastal plain itself, which was covered by forests of eucalypts and swamp oaks—these, especially from the present site of Wollongong to Tom Thumb Lagoon—but in the gullies between the spurs of the scarp, where the surface was covered with semi-tropical forests, isolated remnants of which are seen now beneath the protection of the scarp at Bulli and Cambewarra particularly, and of which many cabbage-tree palms *(Livistona)* still remain as a rearguard all over the slopes of the coastal ridges. Small centres of population grew up, not far apart, but having little communication because of the difficult nature of the country.

The industry flourished as late as the thirties, and records show that cedar-getting was a very important industry in Illawarra in 1823, especially round Coalcliff; so important and extensive, in fact, that it was found impossible to administer the affairs of Illawarra from Sydney, so that a detachment of military was sent to Red Point. Meanwhile the second industry had begun to take its place.

In December, 1817, Governor Macquarie reported that "an extensive rich tract of country fit for the purpose of pasturage and agriculture has some little time since been discovered about forty-five miles to the south." He accordingly determined to send yet another survey party to investigate its possibilities, "in case the land lying between Illawarra and Port Jarvis should be found a good quality and fit for pasturage and agriculture." This he did, but reports later (1820) "that Mr. Oxley does not consider Jarvis Bay an eligible place for establishing a settlement, nor does he speak so favourably of the intermediate country." Two years later, however, Alexander Berry reported that he had found "good land, both forest and alluvial," and was favourably impressed with the suitability of Jervis Bay for a large settlement. About the same time Judge Field is reported to have said that "Illawarra is a fine district, of good grazing and some excellent arable land."

We find the first indication of grazing in 1804, when several of the wealthy settlers of the Sydney hinterland used the Illawarra coastal plain for agistment during the drought period, but this was not by any means a permanent arrangement. Another drought in 1813 caused real interest in the Illawarra and several requests for land grants were made to Governor Macquarie, who granted land to those whose stock were without means of support. All the country round Liverpool was burnt up, and a good number of young cattle were brought from Sydney to Five Islands by boat. The owners still lived in Sydney, and sent one or two stockmen with the cattle on the coast. There were few good tracks, and the men lived in very primitive huts. It was not long, however, before permanent settlers began to be interested in the district. The first of these was Mr. David Allen, who had a grant of 2,200 acres in 1817 at Five Islands, and by 1819 those men who were only depasturing cattle in Illawarra were requested by the settlers to remove their cattle, or to acquire permanent grants of land and to keep their animals within these limits. By 1828 we hear that all the low lands were used as grazing country, with a few isolated patches of cultivation—mostly maize, for the individual use of the settlers. By this time the owners began to find a market for butter made on the farms, and the beginnings of dairying were seen.

All the Governors until the forties were interested in dairying, and raised dairy cattle on their own account, so that a nucleus of dairy animals was not wanting. Captain W. Cox raised excellent cattle in the beginning of the century, which were for a long time in great demand by the pioneer settlers of County Camden, and especially the Illawarra partion of it. In 1818 Colonel Johnston had the Macquarie Gift Estate in Illawarra, whither many valuable cattle were sent from his Liverpool Estate. The red and white cattle were the pioneers, and Mr. David Johnston imported roan Shorthorns from England.

A very elementary form of co-operation was formed by these early settlers. Naturally there were a great many difficulties in transport, and when the produce reached Sydney there was "no recognised system by which it could be disposed of" (McCaffrey), and it was found necessary for each farmer personally to take his products and attend to their sale in Sydney. Kangaroo Valley was first settled in 1818, and it was generally thought that there would never be a convenient road thence to Jervis Bay: but now fresh milk is sent twice a day to Sydney by such a road. In 1821 the boundaries of County Camden were marked, and a road was begun to Appin. 1823 was a drought year. About this time, too, the exorbitant measures of the middlemen in Sydney scarcely encouraged small settlers in the production of butter.

No account of the growth of dairying in the South Coast could be complete without a report of Alexander Berry. In 1820 Berry explored part of the coast in order to select a piece of land for which to apply. He went inland from Crookhaven to Nowra Hill, and decided to take his grant on the banks of the Shoalhaven. He formulated a theory that the Shoalhaven used to enter the sea where Nowra now stands, and that the area that is now the delta was a large bay which the river had silted up.

The maximum land grant of those days was 2,000 acres and twenty men, but Berry was granted 10,000 acres on his agreeing to support one hundred men. This land lay on both sides of the river, and the Berry (or Coolangatta) Estate was established. It was very considerably increased later. Berry's first activity was to cut a canal through the isthmus that separated the Shoalhaven from the Crookhaven, so cutting off Comerong Island, which was immediately claimed by the Government. In spite of some ridicule and discouragement, Berry and has partner, Wolstoncraft, began successfully to clear the scrub and reclaim the swamps. They began dairying on an extensive scale, the herd almost entirely of Holsteins, and started a factory at Jindiandie, which is still flourishing.

It is undoubtedly due to the foresighted initiative of these men that the area around the Shoalhaven delta has been so successfully exploited. In 1829 a list of towns in the Illawarra district was published by proclamation, and included Five Islands (Wollongong), Kiama, Shoalhaven (Nowra), and Gerringong.

In 1833 there was another great drought, which discouraged a great number of the smaller settlers, who never returned. At that time Wollongong butter was selling in Sydney for 2/3 per lb. In 1836 there were 6,000 acres under cultivation, and the Australian Auction Co. was formed.

The results of the financial crisis of the twenties now began to be felt in the South Coast, and land was very cheap. Naturally, there were a great many difficulties in transport at this time, and it was difficult to find a market in Sydney. In 1860 a bad outbreak of rust in the wheat crop caused more weight to be thrown on to dairying, and a great deal more land was cleared. The hillsides were favourite situations for more intensive cultivation, and presently the soil became exhausted. Soon it was found that the swamp lands were more valuable. After this year dairying and the raising of pigs, both intensive industries, became the recognised occupation of Illawarra farmers. The methods were still crude, and milk was skimmed and butter made on the farm. English grasses about this time began to replace the natural pasturage.

Kiama led the way in co-operation in establishing a cheese factory. Omega followed with a condensed milk factory. The first butter factory appeared in 1883, again at Kiama, and another the following year at Albion Park; and by 1887 there were two at Jamberoo. Kiama in those days was the centre of dairying activities, and from here the first real co-operative movement sprang.

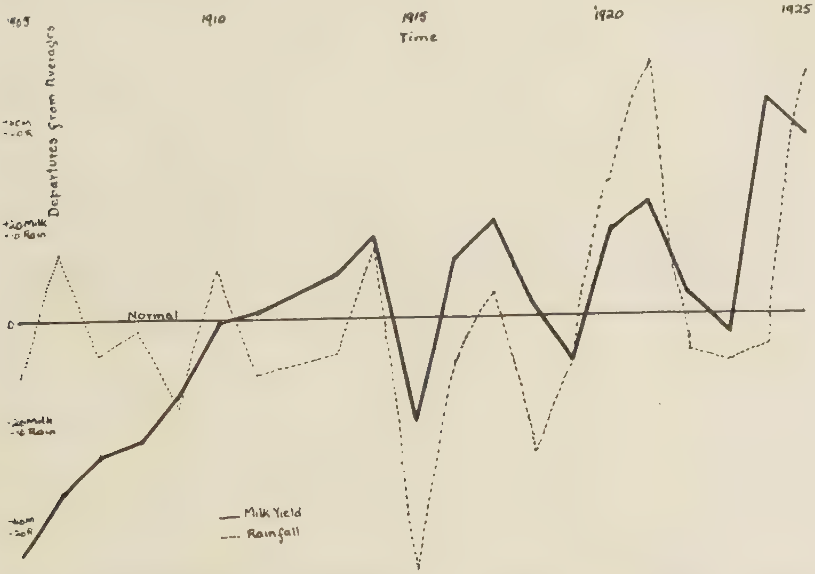
3.—Dairying in North and South Coasts.—It has been shown that dairying represents the last stage in the intensifying of agriculture, and if we plot the proportion of land used for mixed farming and that used for dairy farming alone, in the coastal areas, we find that there is considerably more used for mixed farming in the North Coast than in the South, although in both the amount of land used for dairying alone is greater than that used for mixed farming. It is natural that this should be so, because the North Coast has not been developed as dairying country so long as the South, and now dairying is the biggest industry of both.

The most important factor in the production of milk is the rainfall. Average annual rainfall is important, and season and reliability of rainfall even more so, as far as the production of fodder crops is concerned. In 1914 the North Coast produced 115,000,000 gallons of milk with a rainfall of 54.5 inches for the year, most of which fell in winter. The next year—1915—however, was a bad drought year, only 21.5 inches of rain falling, and the milk yield fell to 78,000,000 gallons. Two years later, with 49.1 inches, 118,000,000 gallons of milk were produced; and in 1921, a record year for rain, approximately 72.8 inches falling (with 37.55 inches in the summer and 35.23 inches in the winter), 122,000,000 gallons were produced; while 1925 with 71.4 inches, produced 135,000,000 gallons.

Naturally, the milk figures for the North Coast do not appear to depend so exactly on the rainfall as those of the South Coast, because, as has been explained before, the industry is still developing rapidly, and account must be taken of this fact. Co-efficients of correlation between the milk yields of the North and South Coasts and average annual, average summer, and average winter rainfalls for twenty years have been calculated, but the results are not as satisfactory as they might be, for this same reason, and also because records of the milk yields are not obtainable for a long enough period.

The milk yields for the South Coast during these twenty years are very much more stable, because the industry has been so long established there. In twenty years the biggest departure from the average yield was only plus 6.7 (in 1906 and again in 1921 and 1924), while in the North the biggest departures were minus 47.7 in 1905, plus 43.3 in 1924, and plus 36.3 in 1925. The co-efficients appear to show that there is a closer correlation in the North between winter rainfall and milk yields, and in the South between summer rainfall and milk yields. Native paspalum is the main pasturage in the North Coast. In the South some English grasses are sown, and these, together with some paspalum and ensilage, are used as fodder.

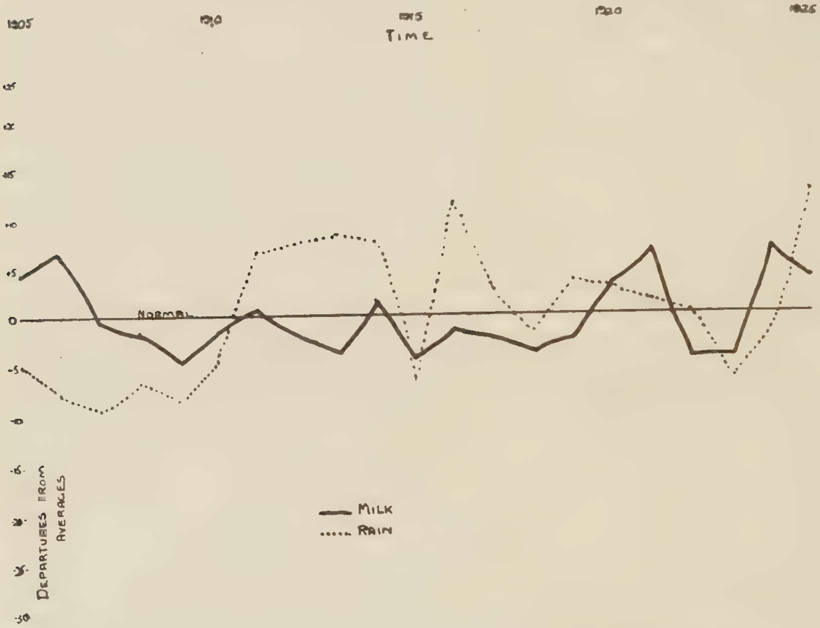
Methods of butter production are much the same in both North and South Coast areas. At one time the farmer took his milk to the factory, where it was separated, and he was paid for the number of gallons he brought, and took back the skimmed milk to feed his pigs. This meant that the farmer living some miles from the factory was at a disadvantage, since, for lack of speedy transport, he either had to waste time taking milk in each day, since it could not be kept, or lose by only delivering once or twice a week. The introduction of the home separator in the early part of the century changed all this. The farmer now separates his cream at home, and, since cream keeps for several days, he need not lose materially by not delivering every day if he lives at a distance. Since the introduction of the Babcock test, he is paid for the amount of butter-fat in his cream.



Graph of North Coast Milk Yield and Summer Rainfall, 1905-25

In the Illawarra district there are a number of milk depots for the collection and pasteurisation of milk to be sent to Sydney. These are in central positions in each milk-producing area, and are sometimes simply pasteurising plants close to the railway, and sometimes at the butter factories.

It usually pays the manufacturer better to make butter than cheese, but this is not always true, and depends to a considerable extent on the state of the market. It takes 2½ gallons of milk to extract enough cream for one pound of butter, and only one gallon milk, all of which is used, to make one pound of cheese. We do not make sufficient cheese for export yet, nor even enough for our own consumption. It costs less to begin a cheese factory than a butter factory, and several attempts have been made to put cheese-making on a firm footing in the North Coast, but it is too hot for large-scale production. There are, however, a few cheese factories in the Macleay district, most of which surmount the difficulty of temperature by making cheese twice daily. Like most of the butter and cheese factories of the State, they are co-operatively owned by the producers.

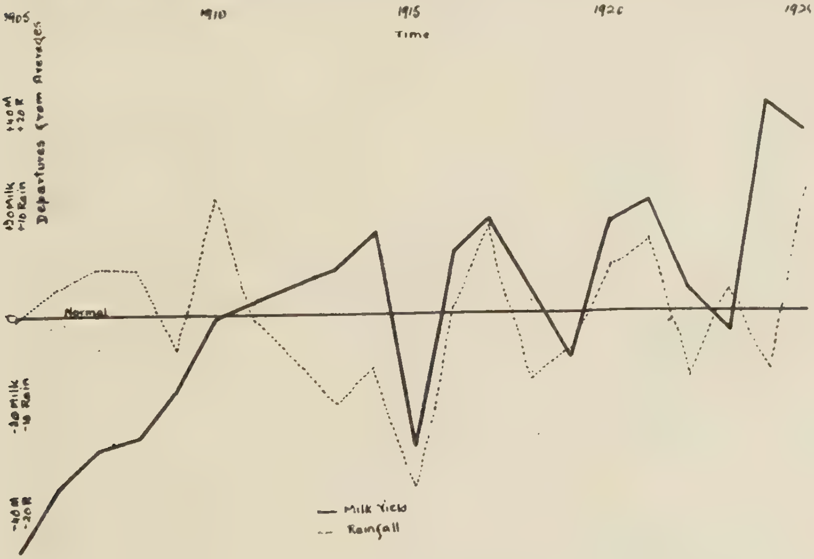


Graph of North Coast Milk Yield and Average Annual Rainfall, 1905-25.

Last year (1927) there were 51,345,311lb. of butter, 1,546,063lb. of cheese, and 8,006,681lb. of bacon and ham produced in the North Coast, and 8,036,738lb. of butter, 3,748,985lb. of cheese, and 412,342lb. of bacon and ham in the South Coast. The difference in the production of bacon is due to the fact that most of the pigs of the South Coast are sent to Sydney for slaughtering.

The dairying areas in the North Coast coincide with the river valleys, so that each valley is a somewhat isolated community, having its own butter factories and carrying on its own export to the metropolis by rail and sea.

By far the most vigorous and richly endowed of these is the Richmond basin, which has an average of thirty cows to the square mile, and up to 100 per square mile round Lismore. The area round Casino carries almost one cow to the acre. There is no other district in the State to equal the Richmond valley. The milk yield rises to over 50,000 gallons to the square mile on the low Richmond pastures, on the Lismore basalt areas, and round Byron Bay. The climate is almost sub-tropical, with moist, hot days and cool nights in winter. There are butter factories at Murwillumbah, on the Tweed, Kyogle, Ballina, Lismore (the last three with bacon also), Nimbin, Bangalow, Casino, Alstonville, Coraki, and Byron Bay. This latter factory is the largest in the State, and is owned by Norco Ltd. (lately the North Coast Co-operative Company). Bacon-curing is carried on there as well. Transport here is fairly efficient. Coastal steamers come up the river to Lismore, and there is a branch line of the main railway from Sydney to Murwillumbah, from Casino to Kyogle. The main roads between centres are in fair condition.



Graph of North Coast Milk Yield and Average Annual Rainfall, 1905-25.

The Clarence basin is much more extensively used for mixed farming than for dairying only. There are large areas of excellent alluvium along the main stream, surrounded, however, by sterile Triassic beds, so that the good soil is only a comparatively narrow strip and not a wide area like the Richmond valley. There are butter factories at Maclean, Ulmarra, and Grafton, the last two of which carry on bacon-curing as well. Coastal steamers can come up the fifty miles to Grafton.

The third district comprises the Macleay, Nambucca, and Bellinger Rivers. The milk yield here is from 10,000 to 30,000 gallons per square mile. The Macleay district has been settled a good deal longer than the more northerly districts, and land is fairly expensive. Around the two smaller rivers the land is still uncleared to any great extent, but a rapidly-growing population is cutting back the timber. Butter factories are at Coramba, Coff's Harbour, Dorrigo, Bellingen, Raleigh, Bowraville, Macksville, Taylor's Arm, Toorooka, Smithtown, Frederickton, and Kempsey. Bacon is cured at Dorrigo and Bowraville. The Kempsey and Frederickton factories produce up to forty tons of butter per week. There are several cheese factories on the Macleay, and the Nestle-Anglo-Swiss Company owns a large condensary which uses up to 12,000 gallons of milk per day. The Macleay is navigable for thirty miles upstream by steamers of fair tonnage.

The Manning and Hastings basin and the Comboyne plateau comprise a fourth district. Dairying here began in 1892, when the Manning River Co-operative Dairy Company Limited opened a small factory. Since then the industry has developed rapidly and surely along the river flats and the basalt Comboyne area. There are now factories at Port Macquarie, Wauchope, Comboyne, Kendall, Jones' Island, Taree, Wingham, Dyer's Crossing, and Tuncurry. The Manning River Dairy Co. produced 3,890,068lb. of butter in 1926, and the Gloucester Dairy Co. and the Wingham Rural Society each over 1,000,000lb. The Wingham factory produces 261,450lb. of bacon and hams annually. As in all the other districts, the factories on the rivers have an efficient launch service collecting cream from the river farms. Coastal steamers can reach Wingham, on the Manning.

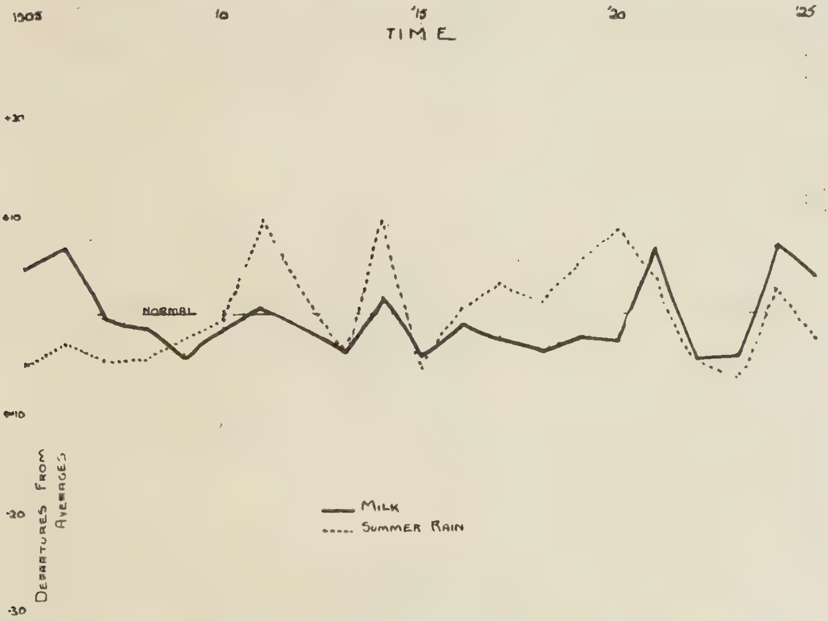
In the South Coast, dairying does not fall into distinct districts along river valleys, as in the North; it is spread more evenly along the coastal plain, but there are four main dairying areas.

Of these the first is quite unlike the other three. It is the district from Lake Illawarra to Kiama. The coastal plain here is interrupted by basalt spurs from the plateau to the west, and falls into four parallel valleys, each having a central outlet for its milk. The district centring round Dapto lies between Mt. Kembla to the north and Mt. Macquarie to the south, and is perhaps the poorest of the four valleys. Between Mt. Macquarie and Stockyard Mt. is the district with Albion Park as its outlet, and south of this, between Stockyard Mountain and Dhruwalgha Mountain, is the Jamberoo district, and Kiama is the centre of the area between Dhruwalgha Mountain and the Saddleback.

The Dapto and Albion Park areas are drained by the Macquarie Rivulet and its headwaters. The country immediately surrounding Lake Illawarra is not valuable. It is badly drained, so that the soil is acid, and it supports only swamp oaks, from which it is known locally as the Illawarra Oak Flats. Behind this tract, however, the rolling foothills of the tableland, with their benching and rich basaltic soil, form excellent country for dairying.

The Jamberoo and Kiama districts are drained by the Minnamurra, a smaller stream than the Macquarie, which rises a little south of the Stockyard Mountain and enters the sea near Stack Island. Here the Minnamurra and Terragong swamps form wide, flat areas of luxuriant grassland eminently suitable for grazing.

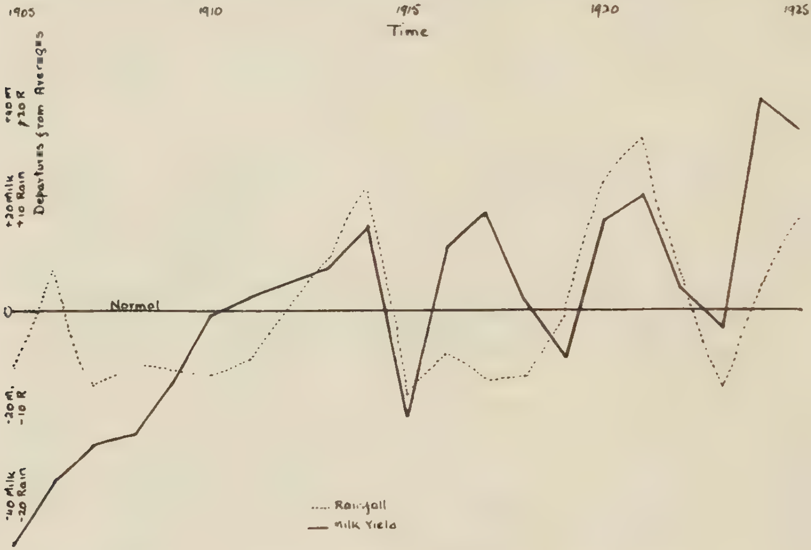
There are butter factories at three of these centres—Dapto, Albion Park, and Jamberoo—as well as milk depots, and a depot at Kiama. The milk is brought from the surrounding farms to the central depots, most of which are directly on the railway line, whence it is forwarded to Sydney in most cases after pasteurisation. The Fresh Food Co. Ltd. pasteurises its milk after it reaches Sydney.



Graph of South Coast Milk Yield and Average Annual Rainfall, 1905-25.

The second area, from Gerringong to Nowra, is totally different. It consists almost entirely of the Shoalhaven delta and Coolangatta swamps. It is a network of small streams branching from the main river and meandering through the silt flats. The Berry Estate consists largely of the fertile Coolangatta Swamps, covered with good grasses and well watered, and it produces up to 100,000 gallons of milk per square mile. There are a number of farms on the silt jetties and benches for some miles up the river above Nowra. In this district are depots at

Jindiandie, Bomaderry, and Jasper's Brush, as well as at Berry, where there is a butter factory. There is another factory at Nowra, across the river from Bomaderry, where there is a condensary, as well as the milk depot. Nowra is the southernmost area for milk transport to Sydney. There is a well-organised launch service up and down the Shoalhaven for eight or ten miles both ways from Nowra, for collecting milk and cream, the milk to be pasteurised at the Bomaderry depot, and the cream for the butter factory at Nowra. The smaller coastal steamers can come the ten miles from Crookhaven Heads to Nowra to load butter.



Graph of North Coast Milk Yield and Winter Rainfall, 1905-25.

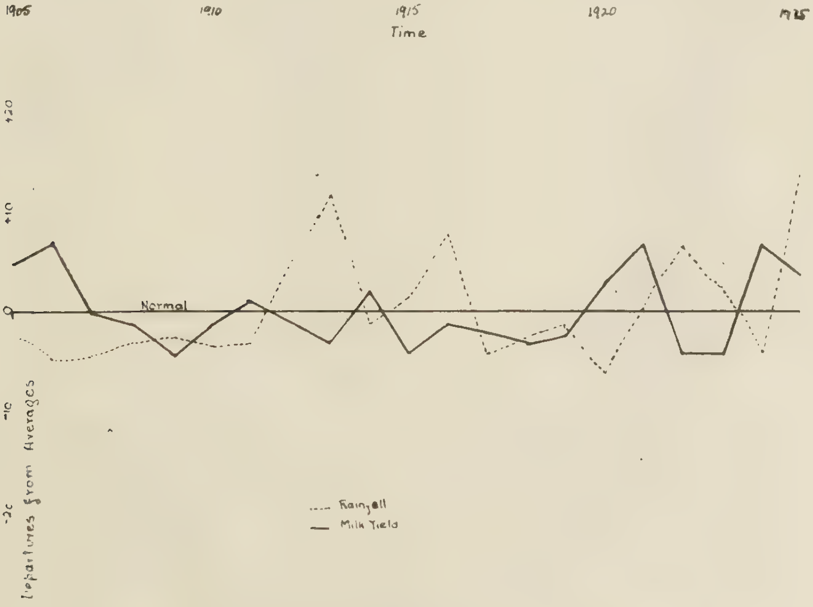
South of Nowra the cheese-making begins. Ulladulla is the third district, consisting this time of an undulating coastal plain about six miles wide. The dairying takes place on the outcrops of diorite in the Milton district, and on the alluvial deposits of the small creeks crossing the plain. It produces 20,000 to 30,000 gallons of milk per square mile. There is a combined butter and cheese factory at Milton, and a cheese factory at Yatte-Yattah, three miles away, the butter and cheese being shipped at Ulladulla for Sydney markets.

The fourth area is the Bega district—a large one on the granite country of the Bega River. It about equals the Berry district in milk production, and there are butter factories at Bega, Cobargo, Candelo, Bemboka, and South Wolumla; and cheese factories at Central Tilba, Tilba Tilba, Kameruka, Moruya, Narooma, and two at Bodalla. The only bacon factory in the South Coast is at Merimbula. Tathra is the outlet for this area.

This concludes some account of dairying in the coastal regions. There is a great scope for its further development in the North Coast; not so much in the South, which is less well watered, has less rainfall and colder winters, and where the soils are not so good. There is little doubt, however, of the continued milk supply to the metropolis from the Illawarra district, and the continued increase in butter production in the North Coast.

V.—AGRICULTURE AND TIMBER.

1.—Maize.—We may now turn to a consideration of the main crops of the coastal districts. Of these, maize is undoubtedly the largest, the North Coast, particularly the Tweed, Richmond, and Macleay Rivers producing one-third of the maize of the State. The cultivation of maize used to be much more extensive in New South Wales before the wheat export assumed importance, and it reached its maximum output in 1910. Because wheat is preferred as a foodstuff in the world market, maize tends to become chiefly a local fodder crop. In 1925 only 39 per cent. of the total value of maize produced was received from export, whereas 67 per cent. of the total value of wheat produced was thus received in New South Wales. Maize needs a hotter and moister climate than wheat, which cannot be satisfactorily grown on the coast. It gives a much quicker return than wheat, and can be grown in much more rugged country, yielding at the same time twice as much per unit of



Graph of South Coast Milk Yield and Winter Rainfall, 1905-25.

land. It is a convenient crop for a farmer without much labour, because it does not need to be harvested immediately upon ripening, as with other grain crops, and, again, it is easily grown on the slopes of hillsides, whereas wheat demands flatter country. Oats and hay are usually grown on the same areas as maize, but in different seasons. The best season for maize is the warm, moist summer. For the year 1924-5 the total yield of maize for New South Wales was 4,208,200 bushels, and of this the coastal areas produced 3,066,886 bushels, 1,783,747 bushels of which came from the North Coast and 425,220 from the South. The Milton and Tilba Tilba districts in the South Coast produce relatively large amounts of maize, but the summer is not warm enough for the best possible production here.

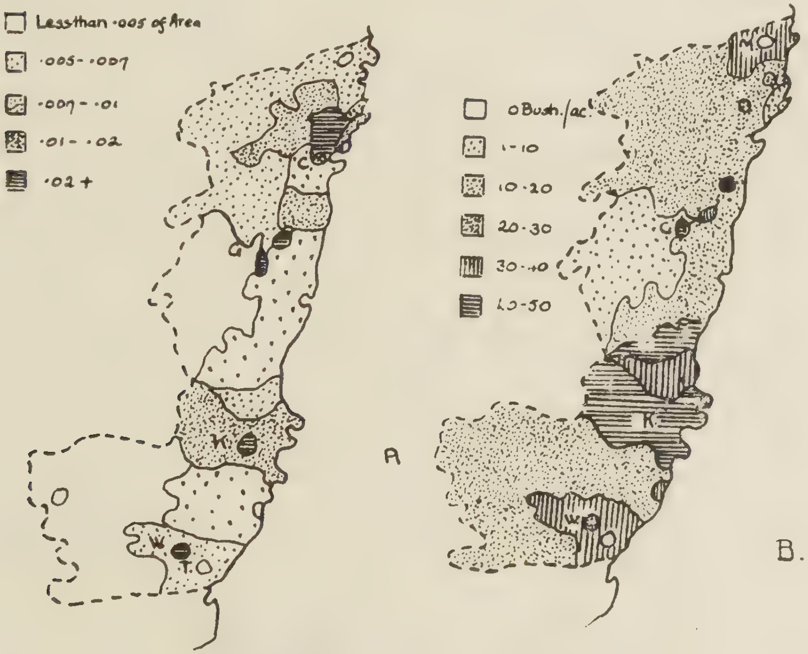
Year.	Total production of maize in bushels. N.S.W.	Yield per acre.
1900-1	6,293,000	30.5
1910-11	7,594,000	35.6
1915-16	3,774,000	24.5
1916-17	4,333,000	27.9
1917-18	3,500,000	24.0
1918-19	2,092,000	18.3
1919-20	4,052,000	29.7
1920-21	4,176,000	29.0
1921-22	3,976,000	27.1
1922-23	3,287,000	23.8
1923-24	4,623,000	27.7
1924-25	4,208,000	28.7

Sorghum, millets, and lucerne for fodder are grown for local consumption, and the coast potatoes are the finest in the State, both North and South, particularly in the Sassafras and Dorrigo regions. Two crops of potatoes can be grown in the same land—one maturing in late spring or early summer, and one in autumn. The latter crop, however, is usually subject to disease, and so most attention is given to the first crop.

2.—Sugar Cane.—The North Coast grows the only sugar cane in the State, since it needs a warm climate of good rainfall, free from frosts. Droughts will spoil the quality rather than the quantity of the cane. Co-efficients of correlation of sugar with temperature and rainfall have been worked out for the first twenty-five years of this century, but they are scarcely satisfactory, since the industry is so young and has been developing so rapidly during that time.

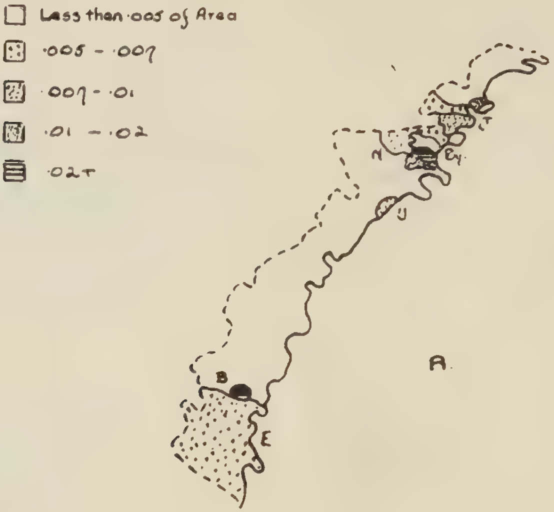
3.—Fruits.—Until lately, of course, most fruits, except apples and citrus fruits, which keep and carry fairly well, had to be sold locally because they are extremely perishable. But new methods of cold storage and transport have altered this, and, together with the more recently introduced drying and canning of fruits, are making their marketing more sure, and consequently encouraging the development of the industry. Already there has been a great increase in production since the beginning of the century, due to a great extent to greater science in checking pests and in feeding the ground.

Climatic conditions are such in New South Wales that fruit of either the temperate or sub-tropical zones can be grown. The North Coast grows sub-tropical and temperate, and the South Coast temperate fruits, chiefly in the Tweed-Richmond and Dorrigo districts in the one case, and the Nowra-Sassafras area in the other.

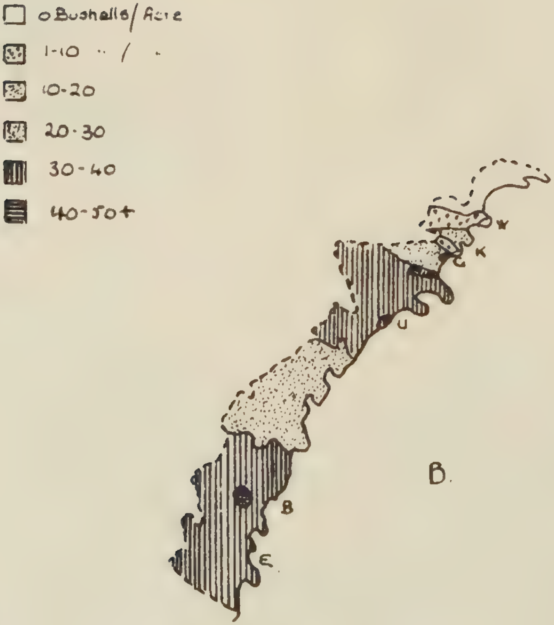


A.—Area under Maize (North Coast).
B.—Yield per Acre (North Coast).

This type of agriculture is of necessity intensive, and needs a great deal of labour and care expended on it. In the north, bananas (the production of which of late years has been retarded by the prevalence of the disease known as "bunchy top"), passion fruit, pineapples, and citrus fruits are the chief crops, with guavas and American grapes on the slopes, especially round Lismore and Grafton. Stone fruits are not very satisfactory here, because of the fruit fly, but form the main fruits of the South Coast, and especially at Sassafras, where apples are also an important crop. Stone fruits and apples are coming into their own about Kempsey and Port Macquarie, in the North.



A.—Area under Maize (South Coast).



B.—Yield per Acre (South Coast).

for the fruit fly and codlin moth do not seem to be so prevalent here as further north. But transport here is difficult, since the country is rough and hilly, so that the fruits produced are only for the local market.

Fruit-growing is becoming more and more specialised and localised. In New South Wales, under the Fruit Pests Act, inspectors are employed to enforce spraying and other measures as a preventative of common diseases.

4.—Timber.—Timber is the remaining important product of the coastal areas. There are two types of forest, tropical and temperate. The one yields mostly ornamental woods, and the other woods for construction. New South Wales contains fairly large areas of temperate forest. The temperate forests occur on the whole where climate and topography are alike good for cultivation, and so trees are destroyed to clear the land. It is natural (but unfortunate as far as the timber is concerned) that land should be used for agriculture rather than for timber, because farm produce gives quicker results and surer value, and timber-getting is difficult, and getting the trees to market is even more difficult. It mostly comes from rugged regions with small population and poor roads, and the markets are far away.

New South Wales has three zones of timber—the zone of coastal timbers, the zone of highland timbers, and the zone of interior timbers. Of these, the zone of coastal timber contains the principal forest lands of the State. The coastal zone extends all along the coast up to fifty miles inland, giving an area of 13,797,000 acres, of which roughly 4,900,000 are known as forest land. It is a region of high rainfall, and produces an abundant supply of hardwoods of a good quality. Softwoods are found in a narrow wet zone on the eastern foothills of the northern highlands. Hoop pine is the chief commercial species.

A Forestry Department was established in 1909, and in 1916 a Commission was appointed to control the State forests and timber reserves, which occupy about 8,000,000 acres in the State. The State forests in the coast district are mainly in the North, from the Hastings to the Karuah Rivers; and in the South, south of the Shoalhaven.

In recent years there has been remarkable activity in the building trade, and consequently the consumption of timber has increased. About 18,054,500 cubic feet was used, apart from building and construction, in 1925. At present New South Wales imports softwoods from New Zealand, U.S.A., Canada, and Scandinavia, but steps are being taken to plant good American softwoods in the State. There is a considerable amount of interstate movement of timbers in Australia.

The following figures and graph indicate how the value of exported timber is increasing:—

Year.	Value of Imported Timber. N.S.W.	Value of Exported Timber. N.S.W.
1901	£459,765	£125,010
1906	£526,413	£335,166
1911	£1,164,372	£268,939
1916	£888,407	£155,451
1921	£2,078,974	£464,725
1922	£1,414,835	£354,957
1923	£1,737,930	£299,269
1924	£2,393,629	£443,927
1925	£1,994,631	£618,233
1926	£2,428,206	£397,128

VI.—MINING AND MANUFACTURE.

1.—Coal.—New South Wales is particularly fortunate in the amount of its coal deposits, and especially in the fact that the two largest deposits occur close to the seaboard, where they can easily be transported by sea to various markets.

Just as the North Coast has been shown to lead in primary production of foodstuffs, so the South Coast leads in industrial production, because of the occurrence of the Southern coalfield in the Illawarra district. Some 2,500 feet of thickness of coal of Triassic or Jurassic age occur in the North Coast about the Clarence basin, but the deposits are not extensive, and the coal is only used locally; but the Southern Coalfield is the southern lip of the great New South Wales Permo-Carboniferous coal basin, and produces large quantities of coal excellent for industrial purposes.

The Southern field has been surveyed by Messrs. L. F. Harper and J. B. Jaquet, who report that there are present Upper and Middle Coal Measures, Upper Marine Series, and Lower Coal Measures, but that there is no representative of the Lower Marine strata which occur in the Northern field (see section on Geology). The Lower Coal Measures outcrop near Huskisson and in the Clyde Valley; but, although they have been correlated with the rich Greta Measures of the North, the seams are thin, and, so far, are not worth working. The Middle Coal Measures are most probably present, but do not outcrop, and it is suggested that they peter out somewhere in the region of Bulli.

It is the Upper Coal Measures, then, which are the most productive. They outcrop from the Shoalhaven to Coalcliff, and are known to contain seven seams, three of which have been worked. They occur in this order:—

The Bulli Seam, averaging 7ft. thick.
The Four-feet Seam, approximately 4ft. thick.
The Thick Seam, approximately 17ft. thick.
Two smaller seams.

The Eight-foot or Tongarra Seam, 7 to 9ft. thick.
The Bottom Seam, about 6ft. thick.

The coal is bituminous, like that of the Northern field, but has a greater percentage of ash, with less volatile hydro-carbons and a higher specific gravity. It is essentially a steam-coal, free burning, but the amount of ash is a disadvantage in stoking, because it requires more labour to remove.

Deposits of kerosene shale occur in lenticular beds, suitable for oil and gas-making.

There are fifteen collieries at present in the Southern field, employing 4,380 men in 1927, in these proportions:—

Colliery.	Number employed.
Bulli	423
Coalcliff	522
Corrimal-Balgownie	397
Corrimal-Balgownie (No. 2)	—
Excelsior No. 1	57
Excelsior No. 2	140
Metropolitan	544
Mount Kembla	315
Mount Kembla (Extended)	84
Mount Pleasant	363
Osborne Wallsend	304
South Bulli	672
South Bulli Shaft	—
South Clifton Tunnel	544
South Kembla	15

The total output from these collieries approximates 2,100,000 tons for 1925. This is an increase of 1,300,000 tons since 1888, the earliest statistical record, when approximately 800,000 tons were produced, chiefly then at Bulli, Mount Pleasant, and Mount Keira. A great deal of this coal is used for coke-making, for bunker supplies for steamers, for the railways, and a good deal is exported, but not as much relatively to these other uses as in the Northern field.

3.—Blue Metal.—Quarrying the basalt round Kiama for road metal is another primary industry which assumes importance in the Illawarra district. There is a saucer of basalt from Bass Point to Kiama, with the Terragong swamps cupped in the centre. Two flows are represented here, the Bombo and Blowhole flows (the Dapto flow is further north), the latter only in the region of Kiama itself. There are nine large quarries in this area, but the demand for the metal is not so great now as it used to be, although the quarries are the largest of their kind in Australia, and they support the majority of the population just here.

The miners here rarely suffer from chest troubles, as those at Broken Hill do, who quarry sandstone, because the basalt contains so low a percentage of silica.

The metal is used fairly extensively in New South Wales, and is sent from Kiama as far as Hay. The Port of Kiama used to be the main outlet for the metal, and was, in fact, the main port of the South Coast; but the railway has taken first place in exporting importance now.

3.—Secondary Industries.—We have now to turn to a consideration of the secondary industries which have grown in the Southern coalfield area.

Coal is the main source of power at present, and consequently any coalfield will be the centre of more or less extensive localisation of secondary industries. The relative importance of fuel for power and of raw materials to be manufactured differs, but the raw materials are usually brought to the coal rather than the coal being transported, because the raw materials are assembled from different centres.

There are several factors governing the localisation of industry, the most important of which are abundance of raw materials and fuel, sufficient supplies of labour, and a proximity to markets. The growth of industries means accumulated capital, and this is as a rule not found in a primary producing district, so that districts where industries are already established are usually the best places to set up new industries, because of this reason, as well as the fact that there is a reserve of labour to draw upon.

Wollongong is the main outlet for the Southern coalfield, and so it is about Port Kembla that most of the secondary industries are clustered. Coal is used in all but the smelting works, where coke is used; and since coke-making is perhaps the largest industry, we may turn to a consideration of it.

The coals of the Southern field are well suited for the making of coke, especially that of the Bulli seam. It is thought that the coals of the other three seams will also be useful, but it has not yet been tried commercially.

There are three types of oven in use—the by-product oven, the rectangular beehive, and the true beehive type. Of these the true beehive used to be used most, but it is wasteful as far as the by-products are concerned, although it is generally agreed that this type is best for high-class coals. The by-product ovens are not used extensively, and have yet to be proved better generally than the rectangular beehive type, which is used most widely.

There are nine companies producing coke in the Southern field—The Mount Lyell Coke Works, at Port Kembla; the Federal Coke and Mount Pleasant Coke Works, Wollongong; Corrimal-Balgownie Company, at Corrimal; the Associated Smelters Coke Works, at Bellambi; the Bulli Coke Works; the North Bulli Co., at Coledale; the North Clifton Coke Works; and the Illawarra Coke Co., at Coalcliff.

Of the industries at Port Kembla, iron and steel-making are, as may be imagined, the most extensive. Steel-making and the manufacture of machinery of all kinds follow. The following account of Australian Iron and Steel Ltd. is extracted from notes supplied by the management:—

The "blowing-in" in pig-iron production of the new No. 1 blast furnace of Australian Iron and Steel Ltd. at Port Kembla, 1928, marks the completion of the first unit of the large modern iron and steel works which the company plans to establish in this locality. The first unit of the proposed works will include an iron blast furnace, steel furnaces, soaking pits, rolling mills for blooms, rails, bars, and all structural sections, and pipe works for the production of De Lavaud cast-iron spun pipes. The works are being laid out to provide for expansion to include the manufacture of all classes of steel products with the least possible handling of materials.

The location of the works at Port Kembla, 58 miles by rail from Sydney, and 1½ miles from Port Kembla Harbour, offers many advantages and facilities for the successful establishment and carrying on of an industry of this nature—both as regards the assembling of raw materials, of manufacture at the plant, and the shipment of finished products to the centres of consumption.

Private railway lines connect the works' site with the South Coast line at Unanderra, and the spur line at Port Kembla; also with Port Kembla harbour, where a pier has been erected by this company for the rapid handling of materials arriving by sea. The pier is equipped with a 20-ton travelling ore-transporter crane, which transfers ore from the ships' holds into railway hoppers for transport to the storage bins at the blast furnace site.

For the present the company will obtain its supplies of iron ore from Wyalla, in South Australia, by arrangement with the Broken Hill Pty. Co. Ltd. Coke will be hauled by the company's locomotives, in its own hopper waggons, from its coke ovens at Wongawilli, a distance of 8½ miles. Limestone will be procured at first from the company's quarries at Excelsior, in the western district of New South Wales. In addition, a fine limestone deposit is now being opened up at Marulan, on the main Southern line, and stone will be transported from the quarry to the blast furnace site, a distance of 74 miles via the Moss Vale-Port Kembla railway, when the latter, now under construction by the New South Wales Government, is completed. Many of the workers have built their houses along the branch line to Port Kembla, so that settlement is beginning to connect the two centres.

Close to the works of Australian Iron and Steel Ltd. is Metal Manufactures Pty. Ltd. They manufacture copper wire and rods, tubing, lead-covered telephone cable, and allied products. Their works are within a few hundred yards of the harbour, to which they are connected by rail, in addition to having a siding connected with the main Illawarra line, and adjoin those of the Electrolytic Refining and Smelting Co. of Australia Ltd., from which company they obtain all their raw copper. The bulk of their remaining raw materials (chiefly lead and zinc) is mined and refined within the Commonwealth.

The Australian Fertilizers Pty. Ltd. form perhaps the best example of the interdependence of secondary industries. They have been situated at Port Kembla for some seven yars. The position was chosen because of proximity to suitable facilities for receiving cargoes of necessary raw materials from overseas, and for the purpose of utilising sulphur available from pyritic ores at the works of the Electrolytic Refining and Smelting Co. Ltd. at Port Kembla, and the supplying of that company's requirements of sulphuric acid.

Their products are sulphuric acid, superphosphate, and mixed fertilisers. They use sulphate of ammonia from steel works in Newcastle, and sulphur from pyritic ore mines in New South Wales, and import phosphate from the Pacific Islands, sulphur from the United States, nitrates from Chili, and potash from France and Germany.

Their markets are the farming lands of New South Wales and Queensland, and so they bear an almost direct influence on primary production. They claim that the scope of their business will be to increase materially the efficiency of production of wheat, wool, and butter, and that their aim is fertilisation of all farming and grazing land. They employ between eighty and ninety men, and, with the Sulphide Corporation, of Cockle Creek, N.S.W., are the only fertiliser-producing companies in the State. There is a railway connection direct to the works and wharf.

These three examples are sufficient to indicate to what extent a coalfield such as exists in the Illawarra district controls the development of secondary industries. The localisation of the industries is not so much a matter of calculation as an inevitable consequence of the supplies of cheap fuel. The industrial development of this portion of the coast cannot equal that of Newcastle, in the Northern field, since the supplies of coal are not so great; but it already has become one of the largest centres of secondary industry of the State, of which Sydney, Newcastle, and Lithgow are the others, forming a large determinant of the distribution of population.

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The History and Decline of the Mining Village of Byng

By UNA R. EMANUEL, B.Sc.

The story of all villages on the western slopes of the Blue Mountains Plateau which have developed as the result of the discovery of some precious metal hidden in the earth is that of decline to-day. Where once stood flourishing mining plants and business centres which supported a large population, now remains a little community of farmers, a few prospectors who still have hopes of wealth, and the local storekeeper and postmaster.

This is the inevitable fate of a mining town when the mineral resources become exhausted, if there is nothing else to take the place of the mining, or if the climatic conditions are bad. Byng is not handicapped in this respect, for the climate is one of the best in the State, so when the mines declined the majority of the miners took up land and settled down to a safer livelihood.

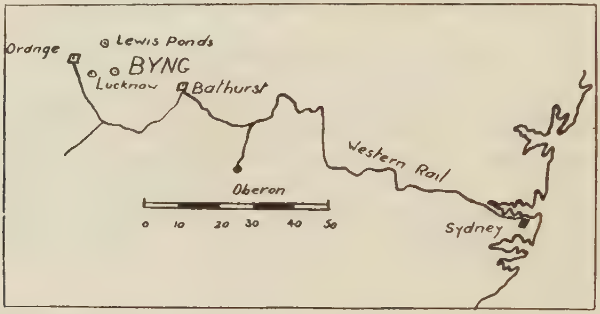
The village of Byng lies twelve miles east-south-east of Orange and twenty-nine miles from Bathurst. It started its career under the name of "Cornish Town," for the population consisted mainly of Cornishmen, who were accustomed to the Cornish mines and so made good miners under the supervision of the old Cornish mine captains.

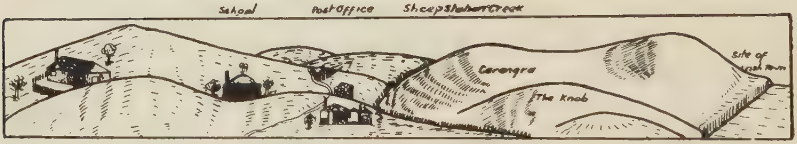
Cornish Town, it is alleged, was first established previous to 1851, for copper was found in the Knob in 1849, but the town did not begin to flourish until gold had been found there in 1853.

According to Mr. James Field, who lives close by, Byng at one time had about 1,000 inhabitants, many of them living under canvas, thought it is thought that there were never more than 500 miners working on one mine. There was a Government school, west of the town, near the Knob, which was attended by 200 children. The old town was a little to the east of the present village, and was actually surveyed and marked out into streets and blocks, though the streets were never made. There were Church Street, Iron Street, and Byng Street, and others. Byng was proclaimed a village on the 20th March, 1885.

The present village is bounded on the east side by Lewis Ponds Creek, and on the west by a tributary called Back or Sheep Station Creek; and into this stream in an easterly direction runs another small creek with flat banks on either side, and these flats, now grassy with tussocks, were once covered with the huts and tents of three hundred Irish miners, with their families, being called "Irish Town." It seems that the Cornishmen and the Irishmen had to be segregated, as they could not live together amicably.

There were three chief mines, Carangra being the biggest and the most extensively worked. It was a gold mine, and all that can be seen now are towering mullock heaps. It has the remains of four big shafts, and there are several tunnels crumbling into ruins, running about 200 yards into the earth. The shafts average about 200 feet in depth. Sheep Station Creek was once dammed up to conserve enough water to wash the ore and to be used in a general way in the process. The ore was ground and separated in a battery at the mine, and the remnants of the crushers remain. The width of the lode was from six to sixteen feet, and was very rich while it lasted. To the west of Carangra is a fairly large house, "Willow Cottage," belonging now to Mr. Hawke, of "Pendarves," where the mine's manager of the last epoch of the Byng mining days lived.





Sketch of Village of Byng.

Near Carangra, on the same hill, but at a lower level, is the Knob, where copper was found in 1849. It is now worked out. In 1894 it was worked by a prospecting party; to-day mullock heaps, five to ten feet high, are to be seen surrounding the remains of three shafts.

The third mine is Whitney Green, on "Springfield" property, which, according to Mr. Field, was the better gold mine of the two. He himself worked on it over thirty years ago, and he thinks that there is plenty of gold still in the earth, but that it is below the level of the ground water.

When the mines (which were worked for approximately fifty years) gave out, the inhabitants drifted away to other fields or settled on the land. To-day Byng consists of five families with about twelve children.

Another mine near Byng, but not within the radius of the village, was Mount Frazer copper mine. Once sixty men were working on it. The copper at one time was smelted at the mine, but this was a failure, so later it was sent to Lithgow, then the mine proved successful for a time. The lode of this mine was eight inches to two feet in width.

The feature of the locality is its extreme patchiness. Valuable minerals have been found at Byng, Icely, Ophir, Mount Frazer, Cadia, and many other places, all within a few miles of each other.

GEOLOGY.—The geology of Byng has not been worked out in great detail, but from a generalised map of the district the main features can be ascertained. The village and the mines lie in a Silurian formation which has been greatly folded. The outcropping rock is fairly soft, flaky, and greyish-green in colour—a serpentine, called by the local people "soapstone." The district surrounding Byng is of volcanic origin, basalts from Ordovician to Tertiary, while round Blayney are Pre-Cambrian to Permo-Carboniferous granites. The Orange district is noted for its rich red soil, but Byng has none, for it lies in the extension of the Lucknow Serpentine belt. From my own observation there seems to be no basalt or granite around Byng itself, although out in the paddocks they certainly outcrop. (From the Geological Map of New South Wales.) All around the region small patches of asbestos are scattered, and there have been several asbestos mines worked in the district. Also there are regions of deep kaolin deposits.

Thirteen Years in the Northern Territory

By Dr. LEIGHTON JONES.

(Summary of Address delivered August 14, 1928.)

A true estimate of the population of this large region is not readily made, for statistics are lacking. In 1910 when the Commonwealth took over the control, there were approximately 1713 whites and 1832 others, mainly Chinese, Malay, Filipinos, and a few Japanese. In 1917-18 the respective figures were 3767 and 1177. In 1925-26 they were 2343 and 1041, which means that after 17 years of administration by the Commonwealth and with a railway line to Katherine and Daly Waters, we find a few hundred extra whites and 700 fewer coloured folks. Darwin is not unhealthy, remarkably few cases of disease being recorded; 1 enteric, 3 diphtheria, 20 or less of measles in 17 years. Even malaria is rarely contracted in the Territory, some cases reported have been carried there by returned soldiers.

Industrial conditions are depressing. An area one quarter the size of Great Britain will be included in one cattle station, and even so cannot be profitably run. Vestey Brothers expended one million pounds on meat works and there are others at Wave Hill and on the Queensland border; but it is doubtful if any have paid expenses or made any profit for years. Land can be taken up at 2/6 per square mile, and will support one beast per square mile. These beasts may fatten under favourable conditions, but they must travel 1500 to 2000 miles to market and are poor at the end of the journey. The small cattle owner may eke out a living by hunting buffaloes. The hides fetch 6½d. per pound and one hide may weigh 80 pounds. Even Vesteys hunted buffalo on the Adelaide River. The great rival to N.T. frozen meat is that of Argentine, and it is not to be wondered that the latter country scores over the region under discussion. A few years ago the cost per beast in Argentine was 35/- as against £10/3/6 in Darwin. This place has to contend not only with difficult natural conditions, but labour difficulties add to her disabilities.

Agriculture fares no better. £50,000 were spent on Daly R. Experimental Farm, now abandoned. Sorghum flourishes till about four feet high, and a tropical storm may chop off all the stalks to a few inches in one act. The Daly River may flood out all the results of labour in one season, and itself vanish from the face of the earth at another.

The climate of Darwin is beautiful for three months, June, July, and August. 60″ to 80″ rain falls from November to April, not that there are many wet days even in the summer, for the rain is mostly from thunderstorms, when 4″ may fall in a few hours. In the wet season it is not the high temperature that causes discomfort, but the high humidity. Leather boots grow green with fungus.

Mining shows little development. The Maramboy tin field yields only poor grade ore, and after an expenditure of £20,000, the dividends are not promising.

All residents join in abusing the Government. It seems impossible to discover any settled policy; seven or eight administrators have appeared and disappeared in 13 years. Parliamentarians who visit the Territory do so in the middle of the best season and can get no true impression.

[Dr. Leighton concluded his address with some reference to the aborigines and their corroborees, and to the work done by the Roman Catholic and other Mission Stations.]

Physiological Aspects of White Settlement in Tropical Australia

By Professor H. PRIESTLEY, M.D.

(Notes on an Address, August 14, 1928)

There is a general belief that change of climate can have a deleterious effect on white people. We must examine the evidence for such a belief. The European Powers, on their first attempts to form settlements in the tropics soon faced many deaths and much illness, and the blame was always laid on the climate. It is questioned whether there is a deleterious effect from the sun's rays, and whether the tropical climate produces anæmia. One point raised little question, but is worthy of investigation, viz., what effect fluctuations in climatic conditions may have. North America, the British Isles and New South Wales offer many atmospheric changes not met with in the tropics. Before the settlement of North Queensland, all tropical settlements were abundantly supplied with coloured people and all heavily infected with disease, some types only found in the tropics and some types found elsewhere but more virulent in tropical regions; so that contact with coloured folk and insanitary conditions have led to the ill-fame of the tropics. Queensland again offers a contrast in mode of living; this is especially noticeable among the white children, where in other hot countries they have nurses and attendants and do too little for themselves, in Queensland our children run about with few clothes on and are notably healthy.

The really tropical area in Australia is limited to a narrow coastal belt. Inland has not the high humidity that so heightens the discomfort of living conditions. North Queensland offers an experiment on a grand scale to test whether climate alone is responsible for loss of health, for here tropical diseases are not common, not even malaria, and we have few coloured people to interfere. Yet Professor Huntingdon draws attention to the fact that the experiment must be recognised as operating on a *selected* population, particularly as regards the women. Again the test cannot be considered complete until many generations have been observed. The dry-bulb temperature gives no picture of discomfort; we must use the wet-bulb and consider the humidity and movement of the atmosphere, as well as its temperature. Comfort depends on the maintenance of a constant body temperature. The body loses heat about as quickly as it produces it; this loss is effected by radiation and by evaporation from skin and lungs. If the surrounding air is nearly saturated, and still, and hot, the body cannot lose heat to it and so feels discomfort. But if the air, though at the same temperature, is not so moist and moving, the body can still lose heat by evaporation and be in comfort. So that air movement is important. As regards sunlight and a deleterious effect from ultra-violet rays, we are told that India and the Philippines have fewer ultra-violet rays than Switzerland for the moisture in the air will absorb them. The idea of the prevalence of anæmia in the tropics is also unfounded. Though the colour of the face is no longer rosy, the trouble is only skin deep, for in the tropics the skin thickens and the pink of the blood is not so readily seen through it. 574 children between 7 and 15 years old on examination proved to be perfectly normal (though "pasty faced"), in the count of red corpuscles and the percentage of hæmoglobin, and many were of the 2nd or 3rd generation of whites in the tropics. The blood, instead of being "thin," may even be a little thicker through loss of water by evaporation. Blood pressure, excreta, etc., seem to be the same in Sydney as in the tropics. Exercise may raise the temperature a little, and the change back to normal is slow. Infant mortality shows a very low rate in North Queensland, but again we must remember that the women especially, may be viewed as a selected group. Much disease is avoided by the general habit of boiling all milk.

But having arrived at the conclusion that residence in the tropics leads to no physiological change of any importance, we must grant that it has a marked effect on mentality. Physical labour may be exceptionally hard and no ill effects accrue. For example sugar-loaders and cane-cutters put up some remarkable records. It is mental effect that cannot be maintained and nervous irritability is common. Among the hewers of wood and drawers of water there is marked industrial unrest. Queensland is indeed the only tropical state in the world where whites do all the manual labour. So we do find tropical neurasthenia. There is no physiological or medical reason against settlement in the tropics, but whether the nerve or mental effect is of sufficient importance to bar settlement, or whether it can be overcome, we cannot say.

In the Track of Flinders. Some Islands of the Great Australian Bight

By Professor T. G. B. OSBORN, D.Sc., F.L.S.

(Summary of Address, October 9th, 1928.)

The position of the smaller islands is indicated by the following:—Franklin Islands, lat. 32° 27′ S., long. 133° 39′ E., 12 miles from nearest mainland: Flinders Is., lat. 33° 42′ S., long. 134° 30′ E.; Pearson Is., lat. 33° 58′ S., long. 134° 15′ E., 40 miles from the west coast of Eyre Peninsula; Sir Joseph Banks Group, generally including Thistle and Wedge Is.; Kangaroo Island.

The island groups are relics of the continental shelf, and until recently were portion of the mainland, of which they now form mere vestiges. The slides showed the constancy of the granitic platform capped by soft sandstone. The capping is of very recent date (post miocene), and consists of wind-blown sand, formed when the sea was retreating south of the present coastline. The sand became indurated owing to the action of water on its calcareous contents. The sea is now washing away these soft sandstones, and the solution of the calcareous matter in the soil and its subsequent deposition, as the water evaporates, in the form of a bed of travertine limestone, is a marked feature.

These island groups offer unique opportunities for field study to botanist and zoologist. The flora is very like that of the mainland, but as regards fauna, each island has one or two species of endemic mammals.

Franklin Island is dull botanically, consisting as it does of a sandy area which an ally of the saltbush helps to bind. The surface is riddled with the holes in any one of which one may frequently find four occupants living, presumably in harmony, namely, rat, bandicoot, melanitic tiger snake, and mutton bird. Wind action is very prevalent, and many "blowouts" are seen where all the sand is swept away and only fragmentary travertine left, partly knitted together by "grape-bush" roots. The heaps of shellfish remains on rock platforms are no relic of aboriginal occupation, but the shellfish have been carried aloft by sea-eagles and dropped from sufficient height to smash the shells and expose the edible portion. The land area here on two small islands is only two miles by half a mile.

Flinders Island is much larger, about 9,000 acres in area; there is even a little fresh water, and some sheep are pastured, but the grazing is not native herbage. A remarkably dense *Melaleuca* scrub was the principal natural cover. The coast is extraordinarily massive and rugged, with cliffs 200 feet high.

Pearson Island, much further from the coast of the mainland, reaches an altitude of 781 feet of sheer granite, with a precipitous slope. The vegetation of this hill is a repetition of that on the granite knolls of Eyre's Peninsula. Among the fauna is noted the sea-lion (or hair seal), of which 200 were massacred recently, for no legitimate purpose, for the pelts are of little value. Curiously, the abandoned skeletons are always accompanied by a heap of rocks or pebbles. It seems these are from the stomachs of the mammals, and have been swallowed as an aid to digestion, as fowls swallow grit. The only large animal is a wallaby, an endemic species *(Petrogale pearsoni)*, and its water supply is a mystery. The south-west gales influence the vegetation, blowing salt spray so that salt-loving plants such as *Mesembryanthemum* and *Arthrocnemum halocnemoides* persist up to 200 feet up the cliffs.

Wedge Island and Thistle Island belong to Sir Joseph Banks Group. They are large land masses used for pastoral purposes and farming. Some of the smaller islands, e.g., Williams Island, have a reputation for being infested with tiger snakes, again associated with the mutton bird.

Kangaroo Island has been mapped and described by French navigators. In places here again is seen the rock platform and indurated sandstone cliffs, but most of the soil is derived from a schist which forms the bulk of the island. The vegetation to-day still includes some extraordinarily dense mallee growth; in places a road must be cut in a solid wall 20 feet high. A lagoon cuts the island almost in two; the smaller eastern end has good soil and grows barley, but the western end is poorer, except around Cygnet River. Two hundred square miles at the far western end is now a fauna and flora sanctuary. The coming of man has led to devastating fires, and to-day the emu (endemic species) described by the French is extinct, and incalculable destruction of endemic wallaby and opossum has resulted. *Xanthorrhoea Tatei* flourishes, with a remarkably huge trunk, encased by a valuable resin, which is collected by chopping it off and so killing 60 per cent. of the plants. Picric acid can be prepared from the resin, but it is more economically used in varnish manufacture.

Ongtong Java

By H. IAN HOGBIN.

Science Research Fellow in Anthropology in the University of Sydney.

(Summary of Lecture given on 12th March, 1929.)

This research was carried out under the auspices of the Australian National Research Council.

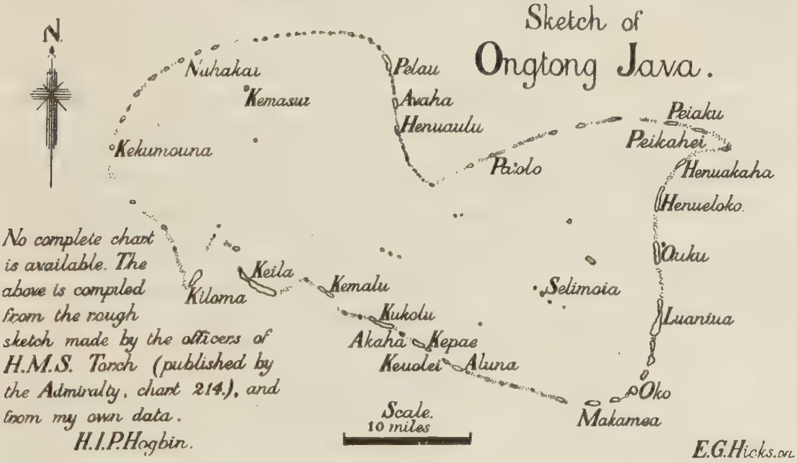
Ongtong Java is made up of more than a hundred small islands arranged in and around a lagoon thirty-five to forty miles long by twenty broad at its widest point. It lies to the north-east of the Solomon Islands, slightly more than 200 miles due north of Tulagi, the capital of the British Solomon Islands Protectorate, and 300 miles east of Buka, the most northerly of the Solomon group. I should perhaps add that the Solomon Islands lie between latitude 5° S. and latitude 12° S., in the Western Pacific, the capital of the southern portion, Tulagi, being 1,610 miles from Sydney.

In naval and other charts Ongtong Java is also called Lord Howe's Group and Leueneuwa. Throughout the Solomons it is known as Lord Howe. I shall not speak of it so here, as in the not very distant neighbourhood there are at least two other Lord Howe Islands. Leueneuwa is obviously a clumsy attempt to spell the native name of one of the main islands, which I shall write Luaniua. There is actually no native name for the group as a whole.

No accurate charts of the group have been made. The

Admiralty has published a sketch, and with the aid of this and my own data it was possible to make some sort of a map. I am indebted to Mr. E. Hicks, of the University of Sydney, for the copy here reproduced.

Topography and Climate.—All the islands are only just above the reach of the tide, and are entirely of coral formation. Further, beyond sand made up of broken fragments of coral and mixed with decayed vegetation, there is no soil, so that the variety of the flora is extremely limited. The largest island is Luaniua itself, which is between four and five miles long, and even at its widest point scarcely three hundred yards broad. The islands are joined to each other in many cases by reefs. At a few points these give way to deep water, and there it is possible for large vessels to pass. Within the lagoon, although it is generally deep, navigation is dangerous, since it is seamed with more reefs.


Sketch of Ongtong Java.

No complete chart is available. The above is compiled from the rough sketch made by the officers of H.M.S. Torch (published by the Admiralty, chart 214.), and from my own data.
H.I.P.Hogbin.

On the lagoon side all the islands have a beach which slopes off into deep water very gradually. On the open sea side there is only a rocky shelf strewn with coral boulders. This runs out for anything up to one hundred yards or more, and then there is a sharp drop to the depths of the ocean.

The climate is equable and rarely very hot, except on the lee side of the island. So thickly do the palms grow that a gale blowing on one side will scarcely be felt at all two hundred yards across on the other side.

There are two seasons, dominated respectively by the trade wind and the monsoon. From the middle of March till about the middle of November the wind is almost constantly blowing from the eastern quarter—that is to say, from south-east to north-east. November and March are subject to prolonged calms and variable winds. From December to February, although there are liable to be calms, the wind swings from west-south-west to north-north-west. Heavy gales are likely to come with either of the two dominant winds.

I have no rainfall figures, but natives confirmed my surmise that there is no marked rainy season, although it is possible that the monsoon is slightly wetter than the trade wind season. If this be so, it is by a very narrow margin. At a rough guess I would say the rainfall averaged between 80 and 130 inches per year. There are, of course, no streams, and the water is obtained by sinking wells. All the wells show a small tidal rise and fall, but the water is only slightly brackish, though it is very hard.

There are but few mammals, and the generally ubiquitous pig is not among them. Rats and flying foxes are numerous, and there are many birds. The lagoon abounds with all varieties of fish.

The History of the Group.—As far as we know, the first Europeans to see Ongtong Java were le Maire and Schouten, in 1616. They were on a voyage around the world by way of the south of Tierra del Fuego. From copies of Schouten's diary at my disposal[1] I am unable definitely to identify their discovery. There are other versions, and to one of these Tasman must have had access, for he recognised "Marken Island" (the modern Marqueen or Mortlock Island), some distance to the north-west, from Schouten's description. I can find no mention of this island at all. Tasman himself saw the group next. The following are extracts from his diary, dated March 22nd, 1643[2]:—

> "At noon we saw land straight ahead of us, at about four miles distance. . . . These islands are close on thirty in number, but are very small, the largest of them not being more than two miles in length; the rest are all small fry, all of them being surrounded by a reef . . . they are about ninety miles from the coast of Nova Guinea.
>
> "To these islands we have given the name of The Islands of Onthong Java, because of the great resemblance they bear to the latter." (Either an island or cape near Batavia.)

Tasman saw land in latitude 5° 2′ south, longitude 178° 32′ east, and made a sketch. Ongtong Java remained unvisited till 1791, when Captain (afterwards Admiral) Hunter, during his voyage from Port Jackson to Batavia in the hired transport "Waaksamheyd" in 1791, after the loss of H.M.S. "Sirius," sighted it and gave it the name of Lord Howe's Group. From then onwards whalers seem to have passed by fairly frequently, but for many years none came inside the lagoon. According to native informants, the crew of the first ship to do this was massacred by order of the king. This was the "James Birnie," and I was able to find a contemporary account of the affair told by one of the survivors, a native woman, to the Sydney "Echo" in 1875. The "James Birnie" established beche-de-mer stations on two of the islands. She had white officers and a New Hebridean crew. These were divided up between the two stations. The Ongtong Javanese, "excited by cupidity," murdered all of them save the mate, who escaped in the ship, apparently, and the woman, the wife of one of the crew, who remained. She describes the massacre thus: "Some were despatched at once; some had ropes put around their necks, after being clubbed, to strangle them; and some were beaten and battered on the head with large stones. The women joined in the horrible work." H.M.S. "Beagle" was sent on a punitive expedition, and the place was shelled and a number of people killed, but the woman was not rescued till some time later when the barque "Sydney" visited the group.

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[1] Latin edition, Amsterdam, 1619; French edition, Amsterdam, 1662; and English edition, Edinburgh, 1768.

[2] Edited by Heere, Amsterdam, 1898, page 41.

This must have been the first attempt at settlement by Europeans; but since the names of four ships which were there about that time are mentioned in the newspaper account, the place must have been quite well known.

In 1893 Germany took possession. Two trading stations had already been established before that date. In 1900 the group was handed over to Britain, with the islands of Ysabel and Choiseul in the Solomons, in exchange for the British rights in Samoa. The Union Jack was hoisted by the Resident Commissioner of the British Solomon Islands Protectorate on August 30th of that year, and from that time Ongtong Java has been under his jurisdiction. Until 1914 there was practically no government interference except for a very occasional visit of the Commissioner's yacht. In that year a government official, Mr. J. C. Barley, spent a month or two there, and he has paid visits at irregular intervals ever since. There are at present two trading stations, and at least one white man is always resident there. Copra and trochus shell are the only two products of the group.

The People.—The atoll of Ongtong Java is peopled by a race of natives who bear many similarities to the peoples of Polynesia. They have the same light brown skin, and their language is a dialect of Polynesian, just as are the languages of Samoa, Tonga, New Zealand, and Hawaii. Unfortunately they are a dying race. In 1900 the population was nearly 6,000; it is now little more than 600. These people live in villages. Their houses are cleanly and well constructed. To a framework of timber are added coconut leaf mats to serve as walls, and pandanus leaf for thatch. The whole house is built without nails. Each part, even to the beams, is tied in place with sennit, the rope made from coconut fibre.

Owing to the limited resources of the islands, the food is restricted to three main items, namely, fish, coconuts, and taro. Taro is a plant which in appearance very much resembles the arum lily. It will grow in almost any swampy land, and the coarse, fibrous root is not altogether unpalatable. The lagoon waters are rich with many varieties of fish, and hauls of forty, fifty, and more are not infrequent. It is the business of the men to catch fish, and this they do with hook, net, or spear.

Ceremonial Customs.—The customs of this people are of great interest. The following are a few of the more important ones:—

When a married couple have their first child, the mother of the husband immediately begins beating anything that comes to hand, frequently an empty biscuit tin or something equally melodious, and that is the signal for everyone in the house to make as much din as she possibly can, singing, dancing, beating sticks—anything. This is kept up for forty-eight hours without ceasing. The relatives of the couple assemble that night, and a dance with songs is held at each street corner. For the space of about a year neither the wife nor the babe is allowed outside the house, and for the same period the husband may not enter it. This means that for a whole year the couple do not see one another, though during this time the man has to provide food for his wife. While he is separated from her, the husband cuts two holes in the *alae* of his nose, each over a quarter of an inch long. This shows that he has reached the status of fatherhood.

The funeral customs are equally remarkable. When a person dies, the body is oiled and ornamented, and that night the nearest relatives weep loudly over it while all the friends assemble to sing dirges. The louder the wailing the more everybody approves; and though doubtless frequently the people are sorry, it is obligatory to weep, whether they are or not. I have heard a man pause in the middle of a long wail to pass a casual remark to someone, and then take up the wail where he left off. The husbands and wives of the dead man's daughters and sons have a peculiar part to play in this ceremony. They decorate themselves with oil, sweet-smelling herbs, and feathers, and sit with their backs to the corpse and their feet towards a roaring fire, which it is their duty to see is always giving enough blaze to illuminate the whole house. Except for attendance to the fire, they sit motionless till morning. When it is remembered that Ongtong Java is within five degrees of the equator, it can be inferred what the atmosphere of a house is like when it not only holds a corpse and a blazing fire but is packed full of people. More may be standing round the doors, blocking the ventilation. This goes on all night. In the morning the body is taken out and buried.

The cemeteries of Ongtong Java are to-day one of its most noteworthy features. The graves are ranged in rows, the foot of each being to the west. At the head of each stands an upright slab of rock not at all unlike those nearer home. These slabs are cut from roof coral, and are given a lime wash. They are very soft, and consequently weather easily, so that the newer ones are sometimes covered with mats for protection. The whole cemetery is overlaid with clean white coralline sand. But there are incidental features far more remarkable. The closest relatives of the dead—that is to say, parents, husband, or wife—live in the cemetery for from one to five years after the death, and are forbidden to take any part in the life of the village. They are almost considered as dead themselves. For a month or two they actually sleep on the grave at night, and even afterwards they may do so in fine weather, though a house is provided in the cemetery grounds. In any case, for the whole period of mourning at least four hours, at fixed times, have to spent every day in sweeping and sitting on the grave. The relatives provide food for these mourners, as for some time it is tapu for them even to cook.

In the past, every year there was a big festival lasting for a month; and though some pretence of it is still kept up, it is but a shadow of what it was twenty or even ten years ago. There are two tribes with centres respectively at Luaniua island, at one end of the lagoon, and Pelau island, at the other. Each tribe had a similar festival, during which the whole tribe came into the main island and many elaborate ceremonies were held. Sacred images were taken out of the temples and were carried in triumphal procession around the village. Then, decorated with garlands, they were left in a high place until the ceremony was over. Solemn dances were held, there was a ceremonial collection of coconuts, and hauls of fish were distributed. One striking part was the obligatory assembling of all the women into two groups, and for two hours it was incumbent upon them continually to swear at one another until finally the men scattered them by chasing them and smearing them with greasy ashes. The culmination of the whole festival was a naked parade of all the unmarried girls. This ceremony is still carried out; the girls are led, painted with pungent-smelling turmeric, adorned with flowers, leaves, and feathers, and crowned with a coronet of sharks' teeth. Then they parade, two by two, hand in hand, along the village street, while all and sundry criticise or praise according to their mind.

One must not judge all this by our standards. Natives must be regarded with insight and understanding. If a people have created for themselves a culture and it enables them to live happily in their environment, it must have vitality and be good. When our own culture goes to the Pacific it takes nothing but death. One is therefore forced to the conclusion that in the island surroundings native culture is infinitely better for natives than our own.

The Geography of the Hunter River Basin

By Mr. C. A. SUSSMILCH, F.G.S.

Director of the East Sydney Technical College.

(Summary of Address delivered April 9, 1929.)

The Hunter River Valley is one of the most important areas in New South Wales. It exhibits extreme diversity, including many types of Australian topography, climate, geological structure and industry. The region under discussion extends about 135 miles westward from the coast, by an average width of 65 miles. The Goulburn River with the lower Hunter together form one simple consequent stream. At Denman the Upper Hunter, draining areas to the north with a larger rainfall effects a junction. The great valley of the consequent river is partly structural; being an area of elevation of not more than 1400 feet, lagging behind the much greater upward movement of the Barrington and Blue Mountain Plateaux to north and south. Subsequent erosion has deepened the valley. The maximum uplift at Barrington (5000 feet) shows a fault escarpment where the stresses were great enough to cause fracture. Barrington and New England Plateaux are flanked by typical mountain ranges such as Liverpool Range and Mount Royal Range, but westward of the main valley the upper Goulburn drains a level tableland and the term "Great Dividing Range" is a misnomer and should not appear in maps and text books as it does so frequently. There is actually a series of parallel valleys and ridges very similar to one another and the actual divide or water-parting is not known, some streams even run parallel to the divide. The only break in the boundary of tableland occurs in what is known as the Cassilis Gap or Geocol, and the valley itself is constricted further east near Branxton where the Mount Royal and Broken Back Ranges converge on the lowland.

Near Branxton the 25″ isohyet abandons its parallelism to the coast and takes an extraordinary eastward kink in response to its configuration. Both Antarctic and Tropical Lows develop tongues of low pressure favourable to rain, but the Hunter Valley is so nearly beyond the reach of both, in its central situation that the main rain bringing winds to this region are from monsoonal disturbances when well developed to the south. The kink in the isohyet at Branxton gives the dry side of the loop a western climate though so near the east coast. The Paterson, Chichester and Williams Valleys rejoice in far better water supply than the lower Hunter, the Chichester is impounded to supply 12 million gallons per diem where the Hunter can yield only 4 million gallons with a far greater catchment area; such is the effect of topography on rainfall.

We may note the asymmetrical arrangement of the Hunter Valley. All the main tributaries come in from the north. This is due to the geological structure. The tablelands north and south are tilted downwards as if to a hinge, but the hinge is not in the centre, being very much nearer to the southern highland than to the northern. Also on the eastern portion the northern rocks belong to a harder series than those of the south. So the present valley is a tectonic feature started first by earth movements. The tributaries are all notably meridional in direction from both north and south. The suggestion made by Professor Griffith Taylor that the main divide used to be a north-south line very much further to the east than at present (so supposing a reversal of the Goulburn to which the Upper Hunter and Wollombi and Fal flowed as normal tributaries where now they enter with boathook bends) is not endorsed here. It is considered that if this explanation is true, it must have obtained long, long ago, for there is no evidence of reversal now, and a structural explanation of present abnormalities rather than a reversal and change of divide appears to be indicated.

The response of industry to geological control may be noted.

1. The oldest rocks are Carboniferous. Acid lavas, sandstones, shales and fragmental volcanic material all yielding a rather poor soil; hence there is little agriculture, but excellent pasturage on this horizon. Rugged topography results from resistance to erosion.
2. Permo-Carboniferous or Permian Coal Measures also break down to rather poor soils, except on river flood plains. Here is good pastoral and dairy country.
3. In the Goulburn River region about Merriwa and Cassilis there are basalt and Tertiary lavas and the soil is the best agricultural land in the State, heavily handicapped by lack of rainfall, so that it is all given over to sheep; Merino wool being grown.
4. West and south of Cassilis occurs the rugged sandstone of some of the least hospitable soil in New South Wales containing only tiny alluvial patches. Hence here we find neither roads nor agriculture and the district has little value from the human point of view.
5. Where dissection has exposed the older Permo-Carboniferous strata, as in the south-east, there is more soil deposition in the valleys and so some settlement.
6. From the basalt tablelands the streams carry down rich alluvium so that the flood plains of the lower Hunter are fairly extensive and valuable: land here and on the lower Paterson and Williams is worth £120 per acre. Much lucerne is grown near West Maitland. The vine flourishes wherever there is a definite lime content in the coal measure soil. Viticulture here is second only to Albury in this State.

Coal Measures.—In Permo-Carboniferous strata is a thick series of coal measures with a large number of coal seams. There are 64 collieries in Newcastle measures, some in East Maitland and a large number in West Maitland. The 33 collieries in the Greta seam are the finest in Australia.

Coal seams occur right up to Muswellbrook, which are yet practically untouched. A more important feature than the value of the coal shipped away, is the development of local industry especially since 1914. Iron and steel industry employs 10,000 workmen and accounts for perhaps 40,000 inhabitants. Broken Hill Proprietary Co. employs 3000. Other industries (such as barbed wire and wire netting, with 600 employees) support 250,000 in the whole Hunter Valley. The by-products of the coal industry are by no means fully utilised, though some small fraction is recovered from the eight million tons of coal which is the maximum annual output. Methods of recovery are still faulty and undeveloped.

With Mawson on the Antarctic Ice

By J. H. COLLINSON CLOSE, F.R.G.S.

(Summary of Address delivered May 14, 1929.)

The Australasian Antarctic Expedition of 1911-14 (fathered by Professors Edgeworth David and Orme Masson) was led by Dr. Douglas Mawson, D.Sc., with Captain John King Davis, R.N.R., second-in-command, and master of the expedition ship "Aurora."

Leaving Hobart, Tasmania, 2nd December, 1911, heavily freighted, the vessel encountered mountainous seas and adverse weather. Bleak Macquarie Island—seal and penguin haunted—was reached 11th December; a scientific party, with stores, landed, and "wireless" station established, with operating staff.

Continuously heavy seas and weather prevailing, en route southward, the disembarking, at Adelie Land, of Dr. Mawson's main base party of eighteen, with Greenland dogs, air-tractor sledge, "wireless" plant, and all requisites (including a whale-boat) was accomplished with much risk, difficulty and delay, by 19th January, 1912, upon a rocky outcrop in the continental ice-wall—subsequently named Cape Denison (approx. 67° S., just within the Antarctic Circle). Captain Davis, then steaming westward some 1,500 miles by sea, and finding no appearance of land, disembarked the Western Base party, at their own desire (the redoubtable Frank Wild and seven others) upon a floating extension of the land-ice—afterwards named the Shackleton Ice-Shelf).

Adelie Land can only be regarded as an intolerable country in which to live, owing to the never-ceasing winds. (The wind-average for twelve months was approximately fifty miles per hour; exceeding all previous records.) The "drift"-laden blizzards having begun in earnest with the completion of our Winter Quarters Hut, this very soon became embedded to the roof—which served, indeed, as a secure protection against the continuously savage hurricanes, besides lessening the cold indoors.

Seal and penguin-flesh, for human consumption, were frozen-in beneath the flooring; seal-meat for the dogs being fed to them in their verandah "shelter."

I merely outline the Expedition's life and work, recommending readers to a personal perusal of Sir Douglas Mawson's informative and finely-illustrated volumes entitled "The Home of the Blizzard"—a popular exposition of Antarctic exploration and adventure that every Australian should read.

The organisation left, perhaps, nothing to be desired in matters of clothing, food, housing, fuel, and cooking-plant; and, throughout, in proof of this, "the health of the Expedition was remarkably good." Jaeger woollens were used principally; with Burberry gabardine wind-proof clothing over all, when out-of-doors. Norwegian furs, for sledging, comprised "finnesko" footwear, sledging-gloves and sleeping-bags. The commissariat —from Great Britain and Australasian sources chiefly—was prudently chosen; whilst the compact, reliable, and happily-devised little dwelling—so fortunately situated for weather-protection—together with an adequate supply of easily-handled coal, completed the essentials for southern polar comfort. (Perfect confidence in the leader—and his well-ordered arrangements, undoubtedly accounted for the general good-fellowship which invariably prevailed.)

Amateur cooking—all participating in turn—was variable, and occasionally amusing. As as offset against the raging inclemency of the outer elements, cooks and "mess-men" were expected to sing to the diners (!) and domestic felicity was often enlivened by farcical burlesque, with gramaphone accompaniment.

Living in blizzard-beaten days and tempest-torn nights, with little let-ups, throughout winter and spring, we frequently experienced snow-laden winds blowing for many hours together at seventy, eighty, and sometimes even ninety miles per hour—with an occasional series of powerful lifting gusts, approximating to a momentary force of two hundred miles an hour. These blizzards were often attended by "St. Elmo's Fire"—an atmospheric electrical "brush-discharge"—whilst the beautiful "Aurora Polaris," ethereal, ghostly, and elusive, displayed its fascinations in almost all weathers during winter.

The persistent wind-force, prejudicial to astronomical observations, also precluded complete "wireless" communication until the ship's return south, in January, 1913, when a stable mast was rigged in comparative summer calm.

Regular scientific work and study proceeded satisfactorily, however, within and without, and the meteorologist, bacteriologist, biologist, geologist, and glaciologist, the magnetic observer, and the recorder of tides each garnered-in his hard-earned and cherished harvest of invaluable data.

Active indoor sledging-preparations long occupied us, and serious sledging commenced in September, when three men reached fifty miles westward from Winter Quarters, "man-hauling" a sledge on land-ice at an elevation of 4000 feet, in wind averaging some sixty miles per hour, with temperatures ranging between zero and -35°F. No further excursion was made until November, when five summer-sledging parties left the Hut, as follows:—A Southern Party, with its Supporting Party; a Near-Eastern Party; an Eastern Coastal Party; and a Far-Eastern Party—this last-named party, alone, employing dogs. In December, a Western Party set out, experimenting unsuccessfully with the air-tractor sledge, which was abandoned. Explorations were conducted, relatively near the coast, varying in mileage—a short coastal survey being made, immediately eastward of the Hut. All parties collected scientific data, and the Southern Party, travelling some three hundred miles from the Hut, took magnetic observations on the South Magnetic Polar area, besides recording, for "Mid-Summer's Day," a night temperature of -25°F.!!

The ill-fortune which attended the Far-Eastern Party (when Dr. Mawson, with indomitable will in the face of cruellest privations, after the deaths of his gallant comrades, Lieut. B. E. S. Ninnis and Dr. X. Mertz, fought his way back to the Hut alone, famished and frozen) precluded completion of that eastern exploration which would have finally linked-up Cape Denison with the westernmost land-discoveries of Scott and Shackleton in that region.

Oceanography and glaciology having, meanwhile, occupied our comrades afloat, Captain Davis, in the good ship "Aurora," relieved the Main Base before mid-February,—high seas, hurricanes, and imminent destruction notwithstanding. The polar navigator, conceiving it his duty to relieve the Western Base immediately—which, as shown, was not on terra firma—detailed six of our party to remain ashore, to search for, and succour the missing sledgers (Dr. Mawson not having, as yet, returned to the Hut). The season, distance between bases, and sea-ice conditions considered, longer delay at Cape Denison might easily have jeopardised everybody concerned. Thus it happened that the Expedition leader spent—with additional benefit to science—a second winter in "the home of the blizzard"—returning to Australia in February, 1914.

Finally, it should be clearly understood that a "dash for the Pole" was no part of this Expedition's programme.

The Rescue of the Southern Cross

By Dr. GEORGE R. HAMILTON

(Member of the Search Party with the Airplane "Canberra.")

(Notes on Address delivered June 25, 1929.)

The objects of the journey undertaken by the airplane Southern Cross are too well known to need mention here. This account deals with the rescue party and the movements of the Canberra. A remarkable feat was achieved in preparing the 'plane in two days for so arduous a task. Weather conditions prevented the selected route being followed, so the track actually lay over Broken Hill, Marree, Oodnadatta, and Alice Springs. From Broken Hill to Marree may be described as all "crash country"—rugged, very dry, and barren. The next "hop" was from Oodnadatta via Alice Springs to Newcastle Waters (815 miles); here also desert country, but more scrub than sand. Around Alice Springs the recent rain made a lovely vivid contrast of new, bright green and the vivid red of the Macdonnell Ranges.

'Plane-travelling has its limitations. It may not be troubled by the bad state of the roads whilst travelling, as is other land transport, but very frequently indeed the only feasible landing-place may be ten miles from the desired settlement, and the airman then has to wait till some sort of conveyance is provided. From Newcastle Waters the course was pursued towards Wave Hill, where one section of the community (consisting of the staff of a wireless station) is ten miles from the other section, including the aerodrome. Maps were not available. Mention had been made of the Ord River and the Victoria River. But recent rain provided a dozen or more large rivers visible from the air, and all looked the same. A course was picked towards Wyndham, on Cambridge Gulf, an inland sea ninety miles by thirty miels in area. Here an interview with West Australian Airways sent the Canberra flying for the Drysdale Mission Station, 150 miles from Wyndham. Here were collected the latest Southern Cross messages, and these wireless communications were the actual salvation of the unfortunate adventurers, for they directed attention to Fort George.

Prince Regent River was investigated, and other tidal rivers in this region. The country here is beautiful, with large mountains and big rivers, and includes much good pastoral land in between, but so rugged and inaccessible that stock could not be got in and out. In this very rough country on the Glenelg River the Southern Cross was located. Food was dropped to the marooned crew, and a map with their location, which the Southern Cross had actually determined to within two miles. The Canberra returned to Fort George, and then negotiated the 500 miles back to Wyndham, returning yet again to the castaways with fishing lines, vegetables, ammunition, mosquito nets, and other supplies. Rescue could only be effected (owing to lack of landing facilities) by a much smaller 'plane than the Canberra. The layman, perhaps, has little conception of the arduous nature of this rescue flight. Amongst other work, the telegraph operator's job of receiving and despatching foolscap-length messages for forty-eight hours at a stretch was not light.

The next duty of the Canberra was to join in the search for the airplane Kookaburra, whose pilot, Keith Anderson, had set out to look for the Southern Cross and was now himself lost. Flora Valley, Turkey Creek, and Tanami were the scenes of operation. At Flora Valley a week was lost waiting for supplies of petrol. This station consists of two sheds, all told, and here the airmen put in time observing the aboriginal population. The men are of fine physique, often over six feet in height. They can walk about apparently unarmed, but trail their spears by their toes. Here the native substitutes for a thermometer record a statement of the number of dogs needed to keep a man warm at night. At last the petrol arrived, but also the news that the Kookaburra was found on the way to Wave Hill. Anderson and his companion also had landed safely, but had perished from thirst. The Canberra records indicated fearful heat and high humidity. A period of two days was considered the limit that white men could go without water under such conditions. Eventually they all discard all clothing as thirst conquers them, and so suffer the more.

The Canberra returned to Sydney after a journey of nearly 9,000 miles.

Geographical Society of N.S.W.

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR ENDED 30th JUNE, 1929.

(Presented at the Annual Meeting in the Royal Empire Society, on Tuesday, 9th July, 1929.)

The Council have much pleasure in presenting their second Annual Report.

President's Address.—At the Annual Meeting held on 10th July, 1928, the President (Professor Griffith Taylor) delivered an address entitled "The Status of the Australian States," a study of fundamental geographical controls. It was illustrated by a number of lantern slides.

The Resignation of Professor Griffith Taylor.—In October, 1928, Chicago University honoured our distinguished President, Professor Griffith Taylor, by inviting him to accept the very important position of Professor of Geography in that University. It was with the greatest regret, therefore, that the Society accepted the resignation of its President, for it was fully aware of the great loss it was sustaining. At the October meeting the Society took the occasion of farewelling Professor Taylor, and of wishing him every success in his new sphere of work.

Membership.—The total membership on 30th June, 1928, was 190; since that time 83 new members have been added, making a total of 273.

INCOME AND EXPENDITURE ACCOUNT FOR YEAR ENDED 30th JUNE, 1929.

EXPENDITURE.		INCOME.	
To Printing and Stationery	£18 1 1	By Subscriptions:	
„ Postages	27 11 10	214 Members at 10/-	£107 0 0
„ Sundry expenses ..	10 3 6	43 „ at 5/-	10 15 0
„ Hire of Hall	23 19 6	2 „ at 2/6	5 0
„ 'Geographer' £84 17 0			£118 0 0
Less Donations 15 2 0		„ "Geographer" Sales	15 8 0
	69 15 0	„ „ advts.	15 0 0
		„ Excess Expenditure over Income . ..	1 2 11
	£149 10 11		£149 10 11

BALANCE SHEET AS AT 30th JUNE, 1929.

LIABILITIES		ASSETS.	
Accumulated Funds at June 30, 1928 £38 12 10		Cash at Bank	£30 14 11
Less Excess Expenditure over Income 1 2 11	£37 9 11	Subscriptions outstanding	15 10 0
Subscriptions paid in advance for year 1929-30—			
14 at 10/- .. 7 0 0			
7 at 5/- .. 1 15 0	8 15 0		
	£46 4 11		£46 4 11

M. F. ALBERT, Hon. Treasurer.

I hereby certify that I have examined the Books and Vouchers of the Society, and that the above is a true and accurate statement of the Society's affairs as shown by the Books.

E. G. TROUTON, Hon. Auditor.

Meetings of Council.—During the year nine Regular Meetings of the Council have been held. The attendance of members of Council at these meetings has been as follows:—

Professor Griffith Taylor, D.Sc., F.R.G.S. (President) (Resigned in October.)	2
Mr. David G. Stead (President)	8
Professor W. R. Browne (Vice-President)	5
Professor L. A. Cotton (Vice-President)	4
The Hon. G. F. Earp, C.B.E., M.L.C. (Vice-President)	6
Miss D. R. Taylor (Vice-President)	8
Dr. Charles Anderson	8
Capt. F. J. Bayldon, F.R.G.S.	7
Professor A. D. Craig	0
Mr. Frederick Daniell	3
Comm. R. C. Garsia	3
Mr. H. W. Hamilton	7
Mr. H. B. Mathews	2
Mr. D. J. Mares .. .. (Resigned in March.)	0

Mr. A. L. Nairn, M.A., F.R.G.S.	9
Capt. A. W. Pearse, F.R.G.S. (Five months' leave of absence.)	2
Miss M. Roseby, B.A.	7
Miss E. M. Slack (Elected in February.)	3
Mr. D. C. Ferguson (Elected in March.)	3
Mr. M. F. Albert (Hon. Treasurer)	0

Council.—The Council record with the deepest regret the death of Professor A. D. Craig. At the resignation of Professor Griffith Taylor, Mr. David G. Stead was elected President. Miss Ella M. Slack was appointed a Councillor in place of Mr. David G. Stead. Professor A. D. Craig was appointed a Councillor in place of Mr. D. C. Ferguson, who resigned. Mr. D. C. Ferguson was re-elected a Councillor in place of Mr. D. J. Mares, who resigned.

Lectures.—The usual course of regular lectures and addresses has been given throughout the year in the Royal Empire Society's Building, and has undoubtedly proved of great interest to members. The Society has also received excellent press notices of the various subjects discussed. Addresses were given as follows:—

July 10th.—"The Status of the Australian States—a Study of Fundamental Geographical Controls" (illustrated with lantern slides), by Professor Griffith Taylor, D.Sc., F.R.G.S.

August 14th.—"Thirteen Years in the Northern Territory" (illustrated with lantern slides), by Dr. Leighton Jones; and "Physiographical Aspects of White Settlement in Tropical Australia," by Professor H. Priestley, M.D.

September 11th.—"Posters as Teaching Aids," by Dr. Marie Bentivoglio.

October 9th.—"In the Track of Flinders—Some Islands of the Great Australian Bight" (illustrated by a series of lantern slides made from photographs taken during the course of different expeditions), by Professor T. G. B. Osborn. D.Sc., F.L.S.

November 13th.—"The Black Heart of New Guinea" (illustrated with lantern slides), by Mr. E. A. Briggs, M.Sc., Acting Professor of Zoology.

December 11th.—(1) "Captain Cook, from a Navigator's Point of View," by Capt. F. J. Bayldon, F.R.G.S., R.N.R.; (2) "Over Hawaiian Waters and Volcanoes," by Mr. David G. Stead (Acting President of the Geographical Society of N.S.W.), illustrated by photographic lantern slides. Mr. Stead gave a short account of his air flights over waters in which Captain Cook sailed and met his death, and also made a brief reference to the volcanoes.

February 12th.—"The Great Whales of Antarctica and Australia" (illustrated with lantern slides) by Mr. David G. Stead, President of the Geographical Society of N.S.W.

March 12th.—"The Customs and Beliefs of the Natives of Ongtong Java" (British Solomon Islands), illustrated with lantern slides, by Mr. H. I. Hogbin.

April 9th.—"The Geography of the Hunter River Basin," by Mr. C. A. Sussmilch, F.G.S., Director of the East Sydney Technical College.

May 14th.—"With Sir Douglas Mawson on the Great Ice Barrier" (a chat about the Australasian Antarctic Expedition, with lantern slides and exhibits of sledging kit), by Mr. J. H. Collinson Close, F.R.G.S. This lecture was prefaced by a short address by Dr. Elkin on "The Glenelg River and the West Kimberleys."

June 11th.—"Australian Bird Life—Its Environment and Economic Importance" (illustrated with lantern slides), by Mr. H. W. Hamilton, B.Sc.

June 25th.—"The Rescue of the Southern Cross" (illustrated with lantern slides and cinema film), by Dr. George R. Hamilton (member of the search party with the "Canberra").

The Council especially wish to convey their sincere thanks to the several lecturers who delivered most instructive and interesting addresses during the year.

Members are advised that a series of interesting and attractive lectures will be arranged for the current year. It is encouraging both to the lecturers and to members of the Society to know that many inquiries have been received in connection with the lectures delivered during the past year, while the subject matter on several occasions has led to valuable discussion in the press.

Journal.—The first issue of "The Australian Geographer" comprised 800 copies. All were very promptly distributed to members or to various institutions on our exchange list, or were sold, except thirty copies retained by the Society, and more were needed. Very encouraging reviews greeted this new publication. Only one issue was found possible in 1928-29, the financial status of the Society not warranting more.

Donations.—The Council has pleasure in recording its thanks to the following donors for gifts presented to the Society:—

Mr. David G. Stead.—Vols. 3 and 4 (bound together) of the Transactions and Proceedings of the Royal Geographical Society of Australasia (N.S.W. Branch).

Angus and Robertson Ltd.—160 volumes of the Proceedings of the Royal Geographical Society in London; and for their very great assistance in printing and distribution of leaflets in connection with the Society's Journal.

Mr. F. J. Broinowski.—Two parcels of valuable maps.

Mr. J. H. Collinson Close.—Special record of the Proceedings of the Geographical Society of A/sia, July, 1885.

Geographical Society of A/sia (N.S.W. Branch).—"The Importance of Geography," by Sir Edward Strickland, K.C.B., F.R.G.S.

Royal Geographical Society of A/sia (N.S.W. Branch).—"First Report of New Guinea," by John F. Mann.

Excursion to Bellambi, South Coast, Saturday, 10th November, 1928.—About thirty members took part in this very enjoyable excursion, under the able leadership of Mr. H. W. Hamilton. Many features of geographic interest were noted, and some time was spent searching for aboriginal artefacts on the kitchen middens so numerous around Bellambi.

Conclusion.—It is most gratifying to note the steady increase in membership; this increase denotes sustained interest in the Society's work, and means the consequent widening of its sphere and influence. The work and aims of the Society will be further strengthened if the members will continue to take a live and personal interest in what is being done. The subscription to the Society (10/- per annum) is exceedingly low compared with the many advantages offered to its members.

On behalf of the Council,
DAVID G. STEAD, President.
MARIE BENTIVOGLIO }
B. M. MACKENZIE } Hon. Secretaries.

PAPERS AND NOTES HELD OVER.

Several papers that were available, also notes relating to several of the addresses mentioned in the foregoing Annual Report, have been unavoidably held over because of the demands on our limited space. It should be understood, also, that the papers, as printed, are more or less reduced. This particularly applies to Miss Catherine Doyle's fine paper on the Localisation of Industry in Coastal Districts of New South Wales. In the original manuscript this contains more than one hundred excellent diagrams, graphs, and sketches, which add greatly to the informative nature of the paper.

It is, perhaps, not out of place to say here that our members and the public who benefit by the Society's work may do much to aid us in providing the necessary funds to enable us to push on with the publication of *The Australian Geographer* in a more ambitious style and at more frequent intervals. The reception accorded our Journal has already been most cordial, and it appears to fill a long-felt need in our educational and intellectual life. Our membership already includes people in many walks of professional, commercial, and educational life. In view of the wide appeal of our work, the membership roll should soon reach many hundreds if our present members will all throw in their full weight of support.—(Ed.)

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Wylie, D. S.	Sydney
Wymark, F.	Sydney
Yarrington, H. de C.	Mosman

MEMBERS AS SELLING AGENTS.

Twelve hundred copies of this issue of the Journal have been printed, in view of the widespread demand for our first issue last year. Members are cordially requested to assist in selling the Journal where it will be of the greatest benefit in spreading knowledge and in adding to the Society's membership.—(Ed.)